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CONTENTS.

☞ An asterisk (*) denotes an illustrated article

Western Gas Association..... 145
Personal..... 145
EDITORIALS—
Reconstruction of Gas Works..... 145
Gas and Electricity as Heating Agents..... 146
The Petroleum Outlook..... 148
Work for the Summer..... 148
Eleventh Annual Meeting of the New England Association of Gas Engineers..... 149
Electric Light in Denver..... 156
Cast Iron..... 157
Edison Electric Light Company..... 157
Sale of the McConnel Tract..... 157
Springfield (Ohio) Water Works..... 157
The Dover Gas Apparatus Exhibition..... 157
Natchez, Miss., Gas Company..... 157

[OFFICIAL NOTICE.]

Western Gas Association.

OFFICE OF SECRETARY WESTERN GAS ASSOCIATION,
ST. LOUIS, MO., March 25, 1881.

The Fourth Annual Meeting of the Western Gas Association will be held in St. Louis, Mo., on Wednesday, May 11th, 1881, at 10 A.M., and continue three days. Due notice of the place of meeting will be given.

LEE A. HALL,
Secretary.

PERSONAL.—Captain W. Henry White, Secretary of the American Gas Light Association, has sustained a severe domestic affliction in the loss of his only child, Florence, whose death occurred on March 8th.

RECONSTRUCTION OF GAS WORKS.

The advance that is being made from time to time in the application of mechanical appliances to lighten and cheapen the labor in the retort house is one of the surest signs of progress.

It is a lamentable fact that a vast majority of our retort houses are still very far behind what they should be in this respect. This is in a great measure due not to a want of appreciation of the value of these appliances, but to the fact that larger works have gradually grown from smaller ones, and in many cases a real or supposed necessity existed for conforming the extensions to conditions already in existence. The fear of losing something, or throwing away something, has been potent with many boards of directors in overruling the suggestions of their engineers as to improvements, when, if their works had been destroyed by an earthquake, and they had been forced to rebuild, the improvements that could have been introduced would undoubtedly have saved enough in a few years to pay expense of rebuilding.

Now, while everything existing should be utilized to the fullest extent no existing arrangement should for a moment be retained if it necessitated the violation of a principle of construction, or cramped and crippled a needed improvement in such a way that its full benefit cannot be availed of. Money spent is sometimes money saved, and the idea of keeping the old and adapting the new to it, as is too often done, is poor economy, and, as a general thing, a poor instrument.

We often hear the remark—"well, that is a good idea, and we would adopt it, but it does not suit our works." Now here is the point where the manager who expects to succeed must take his stand and regard not the present but the future. In many instances the old works have already paid for themselves many times over. It may be the fact that they are doing fairly now; but why should they interfere with doing better by better arrangements. If they are charged off on the books why should they continue to be a constant tax and drawback on the working of the establishment.

The present time seems to be a kind of turning-point in the construction of works in this country. The constant advance made by others abroad renders it imperative that reconstruction should soon commence with us. The system of heating benches by improved furnaces, either upon the regenerative principle, or some modification of it, is now so well established that future arrangements of retort-house floors must be made to conform to the new order of things. The next important step is the mechanical handling of material. The satisfactory solution of this problem demands such an arrangement of floors that gravitation may be relied upon for motive power to a large extent; and what is most satisfactory in this regard is that the same arrangement of levels suits the deeper furnace, the handling of coke below and coal above, and machines on the retort house floor for charging and discharging the retorts.

To make gas that can be sold at a cheap price, all of these improvements must be made available, and must be so adjusted to each other that the maximum of work can be performed with the minimum of labor. With the reduction in the selling price an increase of business will soon follow, and the smaller proportion of profit per thousand feet will be much more than made up by the large amount of business.

Improvements thus judiciously made will surely pay in the end, and the manager who is soonest ready for doing his work properly will be earliest ready to reduce his price and increase his total profits.

[A Lecture delivered, Thursday, January 27th, at Glasgow, under the auspices of the Science Lecture Association.]

Gas and Electricity as Heating Agents.

By Dr. C. W. Siemens, F.R.S., Etc.

[Continued from page 122.]

But independently of the practical question of supply, it is desirable, on the score of economy, to rely upon the solid carbon chiefly for the production of radiant heat, for the following reason :—1000 cubic feet of ordinary illuminating gas weigh 34 lbs., and the heat developed in their combustion amounts to $34 \times 22{,}000 = 748{,}000$ heat units. One pound of solid coke develops in combustion, say, 13,400 heat units (assuming 8 per cent. of incombustible admixture); and it requires $748{,}000 \div 13{,}400 = 56$ lbs., or just half a hundredweight, of this coke to produce the same heating effect as 1000 cubic feet of gas. But 1000 cubic feet of gas cost, on an average, 3s. 6d., and half a hundredweight of coke not more than 6d. (at 20s. a ton), or only one-seventh part of the price of gas.

If heating gas could be supplied at a much cheaper rate, it would in many cases be advantageous to substitute incombustible matter, such as balls of asbestos for the coke or anthracite. The consumption of gas would in this case have to be increased very considerably, but the economical principle involved (that of heating the air of combustion by conduction from the back of the grate) would still apply, and produce economical results as compared with those obtained by the gas-asbestos arrangements hitherto used.

To illustrate the efficiency of this mode of heating the incoming air by what is called waste heat, I will show you another application of the same principle, which I have made very recently, to the combustion of gas for illuminating purposes. Gas engineers have until now been under the impression that a supply of cold air was favorable to the production of a brilliant flame. This is a misconception, which was very general also as regards the combustion of solid fuel in furnaces, until it was disproved by Stirling, by Neilson, and by the introduction of the regenerative gas furnace. The "duplex burner" owes its brilliancy to the heating effect of the one burner upon the other; and my brother, Mr. Frederic Siemens, has more recently constructed a burner in which the flame of the gas is reversed in its action, in order to heat in its descent the ascending current of flame-supporting air.

By the application of the principle of conduction before described, I obtain the hot-air current, in a most simple manner, without interfering with the free action of the flame. The construction of my burner is the same as an ordinary Argand burner, but it takes its supply of gas through an enlarged vertical copper tube. This copper pipe terminates in a rod of highly conductive copper, which passes upwards through the burner, and carries at its top a ball of porcelain or other refractory material. The rod is coated with platinum or nickel to prevent oxidation when heated (almost to redness) by the heat of the flame. The tube is armed with radial plates of copper, presenting a considerable aggregate surface, and abutting externally against a covering of asbestos or other non-conductive material. The waste heat of the flame, or that portion of the heat produced in combustion which is not utilized in luminous rays, serves to heat the ball of refractory material and the conductive rod; and the heat is thus transferred by conduction to the tube, with its laminar radii, between the extensive surfaces of which currents of air are free to ascend toward the Argand burner. The air is thus heated to from 700° to 800°F. before meeting the gas, and the ultimate temperature of the flame is increased to at least the same amount, causing a larger proportion of the heat developed in combustion to reach the point of luminous radiation.

But not only the quantity of light but its quality is improved by the higher temperature obtained. It may appear surprising, but it is a fact susceptible of accurate proof, that the light obtained in the consumption of a given amount of gas may thus be increased by some 40 per cent., and that in this large proportion the deleterious influences connected with gas lighting may be diminished. Gas will thus be better able to hold its position against its more brilliant rival, the electric light, except for such large applications as the lighting of public halls and places, of harbors, railway stations, warehouses, etc., for which it is pre-eminently suited. Add to these improved applications of gas the ever-increasing ones for heating purposes, and I have only to express regret that I am not a gas shareholder.

If, however, gas is to be largely employed for heating purposes, it will have to come down in price; and considering that heating gas need not be highly purified, or be possessed of high illuminating power, the time will come, I believe, when we shall have two services, one for illuminating and the other for heating gas. In many towns two systems of gas mains already exist; and it would be only necessary to appropriate the one for illuminating and the other for heating gas. The ordinary retorts could be used for the production of both descriptions of gas, it being well-known that even ordinary coal will give up gases of high illuminating power during a certain portion of the time occupied in their entire distillation. The gases emitted from the retort when first charged are to a great extent occluded gases of low illuminating power, such as fire-damp or marsh gas, and these should be turned into the heating gas mains. In the course of half an hour these occluded gases, together with the aqueous and other vapors, will have left the coal, which is then in the best condition to evolve olefiant gas and other gases rich in carbon, and therefore of high illuminating power. The period during which such illuminating gases are emitted extends over probably two hours, after which the retorts should again be connected with the heating gas mains, until the end of the process. The result of this *modus operandi* would be that the illuminating gas supplied, say, in London, would probably exceed 20-candle power from Newcastle coal, instead of 16 as at present, whereby the objectionable results of gas lighting would be greatly diminished, and there would be, say, an equal volume of heating gas available, consisting for the most part of marsh gas, which although greatly inferior to olefiant gas in illuminating effect, would be actually more suitable for heating purposes, because less liable to produce soot in its combustion.

The total cost of production would not be increased by this separation of the gases, and the price might, with advantage both to the supplier and the consumer, be so adjusted that the latter, while paying for his illuminating gas an increased price, proportionate to the increase of illuminating power, would be furnished with a heating gas at greatly reduced cost; for the heating gas could be reduced in price in a much larger proportion than the illuminating gas would have to be raised, because it would not require the same purification from sulphur, which renders illuminating gas comparatively costly. The enormous increase of consumption would, moreover, enable the gas companies to reduce prices all round very considerably, without interfering with their comfortable revenues.

For large applications of heating gas to the working of furnaces and boilers, simpler means than the retort can be found for its production. I need not now describe in detail the gas producer which I constructed many years ago in connection with my regenerative gas furnace. In it all the carbonaceous matter of the coal is converted into combustible gas, the solid carbon yielding a supply of carbonic oxide. The resultant mixture of combustible gas contains a very large proportion—averaging 61.5 per cent.—of nitrogen, which swells its volume without in any way contributing to its heating power.

It has been my endeavor for some time to construct a gas producer which without losing the simplicity of the first should be capable of yielding a heating gas of superior calorific power. This producer consists of a wrought iron cylindrical chamber, truncated downwards, and lined with brickwork. The fuel to be converted into gas is introduced through a hopper, and the cinder and ashes work out through the open orifice at the bottom. Instead of a grating for the introduction of atmospheric air, a current of heated air is brought in, either through the hopper or through the orifice at the bottom, and is discharged into the centre of the mass of fuel. The effect is the generation of a very intense heat at that point. The fuel, after its descent through the hopper, arrives gradually at this region of its intense heat, and when subjected to it, parts with its gaseous constituents. At the point of maximum heat coke is consumed, producing carbonic anhydride, which, in passing through the considerable thickness of fuel surrounding this portion, takes up a second equivalent of carbon, and becomes changed into carbonic oxide. Here also the earthy constituents are for the most part separated in a fused or semi-fused condition, and in descending gradually reach the orifice at the bottom, whence they are removed from time to time. Air enters through the bottom orifice to some extent, causing the entire consumption of the carbonaceous matter which may have got past the zone of greatest heat. Water is also introduced here in a hollow tray; and, after evaporation by the heat of the hot clinkers, passes upwards through the incandescent mass, and is converted by decomposition into carbonic oxide and hydrogen gas. The exit orifices for the gases are placed all round, near the circumference of the chamber, ascending upwards into an annular space, whence they are taken through pipes to the furnace or other destination.

The advantages connected with this *modus operandi* consist in the intensity of the heat produced within the centre of this mass, whereby the whole of the fuel is converted into combustible gases, with the least amount of nitrogen. The hydrocarbons formed in the upper portion of the apparatus have to descend through the hotter fuel below, and in so doing the tar and other vapors mixed up with these are decomposed, and furnish combustible gases of a permanent character.

The orifice at the bottom of the apparatus may be enlarged, and so arranged that, instead of ashes only being produced, coke may be withdrawn, and in this way a continuous coke oven may be constructed, which is at the same time a gas producer; or, in other words, an apparatus in which both the solid and gaseous constituents of the coal are fully utilized. The intense heat in the very centre of a large mass of fuel has for its result a very rapid distillation, and thus one gas producer does the work of two or three gas

producers of the type hitherto employed. This more concentrated action will, moreover, allow of the introduction of gaseous fuel, where want of space and considerations of economy have militated hitherto against it, and in favor of the ordinary coal furnace.

It has been already proved that steam boilers can be worked economically on land with gaseous fuel, and there is no reason that I know of why the same mode of working should not also be applied to marine boilers. The marine engine has within the last 15 years been improved to an extent which is truly surprising. The consumption of coal, which at the commencement of that period was never less than 8 lbs. per horse power, has been reduced by expansive working in compound cylinders to 2 lbs., or even less, per actual horse power. The mode of firing marine boilers has, however, remained the same as it was in the days of Watt and Fulton. In crossing the Atlantic one may see a considerable number of men incessantly employed in the close stoke-hole of the vessel, opening the fire doors and throwing in fuel. Each charge gives rise to the development of great clouds of black smoke issuing from the chimney, to the great annoyance and discomfort of the passengers on deck. If, instead of this, the fuel could be discharged mechanically into one or more gas producers, the gaseous fuel produced would maintain the boilers at a very uniform heat, without necessitating the almost superhuman toil of the fireman; no smoke or dust would be emitted from the chimney, and a large saving of fuel would be effected. This change would be specially appreciated by the numerous tourists visiting the Western Highlands. Speaking from my own experience on one occasion, I may say that the pleasure of a trip on the beautiful Loch Lomond was very seriously marred in consequence of the fumigation which my fellow-passengers and myself had to endure.

The change from the use of solid to gaseous fuel would be the prelude probably to another, and still more important change—namely, the entire suppression of the steam-boiler. We are already in possession of gas engines working at moderate expense as compared with small steam engines, even when supplied with the comparatively expensive gas from our town gas mains, and all that will be required is an extension of the principle of operation already established. The realization of such a plan would, of course, involve many important considerations, and may be looked upon as one of those subjects the accomplishment of which may be left for the energy and inventive power of the rising generation of engineers.

Before leaving this branch of the subject, I wish to call attention to a favorite suggestion which I had occasion to make some years ago. It consists in placing gas producers at the bottoms of the coal mines themselves, so that instead of having to raise the coal by mechanical power, the combustible gases ascending from the depth of the mine to the surface would acquire, by virtue of their low specific gravity, such an onward pressure that they could be conducted in tubes to distances of many miles, thus saving the cost of raising and transporting the solid fuel. Glasgow, with its adjoining coal fields appears to me a particularly favorable locality for putting such a plan to a practical trial, and the well-known enterprise of its inhabitants makes me sanguine of its accomplishment. When thus supplied with gaseous fuel, the town would not only be able to boast of a clear atmosphere, but the streets would be relieved of the most objectionable portion of the daily traffic.

I now approach another and the last portion of my address—the attainment of very intense degrees of heat either for effecting fusion or chemical decomposition. Although, by means of the combustion of either solid or gaseous fuel, heats are produced which suffice for all ordinary purposes, there is a limit imposed upon the degree of temperature attainable by any furnace depending upon combustion. It has been shown by Bunsen and St. Claire Deville, that at certain temperatures the chemical affinity between oxygen on the one hand and carbon and hydrogen on the other absolutely ceases, and that if the products of combustion—carbonic acid and water—be exposed to such a degree of temperature, they would fall to pieces into their constituent elements. This point of dissociation, as it is called is influenced by pressure, but has been found for carbonic acid under atmospheric pressure to be 2600°C. (4700°F.). But long before this extreme point has been arrived at, combustion is greatly retarded, and the limit is reached when the losses of heat by radiation from the furnace balance its production by combustion.

To electricity we must look, then, for the attainment of a temperature above that of dissociation, and we have evidence of the early application of the electric arc to such a purpose. In 1807 Sir Humphrey Davy succeeded in decomposing potash by means of an electric current from a Wollaston battery of 400 elements, and in 1810 he surprised the members of the Royal Institution by the brilliant electric arc produced between carbon points through the same agency.

Magneto-electric and dynamo-electric currents allow of the production of the electric arc much more readily and economically than by the use of Sir Humphrey Davy's gigantic battery, and Messrs. Huggins, Lockyer and Liveing, and other physicists have taken advantage of the comparatively new method to advance astronomical and chemical research with the aid of spectrum analysis.

My object is now to show that the heat of the electric arc is not only available within a focus or extremely contracted space, but that it is capable of producing such larger effects as will render it useful in the arts for fusing platinum, iridium, steel, or iron, or for effecting such reactions or decompositions as require for their accomplishment an intense degree of heat, coupled with freedom from such disturbing influences as are inseparable from a furnace worked by the combustion of carbonaceous material.

The apparatus which I employ to effect the electro-fusion of such material as iron or platinum consists of an ordinary crucible of plumbago or other highly refractory material, placed in a metallic jacket or outer casing, the intervening space being filled up with pounded charcoal or other bad conductor of heat. A hole is pierced through the bottom of the crucible for the admission of a rod of iron, platinum, or dense carbon, such as is used in electric illumination. The cover of the crucible is also pierced for the reception of the negative electrode, by preference a cylinder of compressed carbon of comparatively large dimensions. At one end of a beam, supported at its centre, is suspended the negative electrode by means of a strip of copper or other good conductor of electricity, the other end of the beam being attached to a hollow cylinder of soft iron, free to move vertically within a solenoid coil of wire, presenting a total resistance of about 50 units or ohms. By means of a sliding weight the preponderance of the beam in the direction of the solenoid can be varied so as to balance the magnetic force with which the hollow iron cylinder is drawn into the coil. One end of the solenoid coil is connected with the positive, and the other with the negative pole of the electric arc, and, being a coil of high resistance, its attractive force on the iron cylinder is proportional to the electro-motive force between the two electrodes, or, in other words, to the electrical resistance of the arc itself.

The resistance of the arc was determined and fixed at will within the limits of the source of power, by sliding the weight upon the beam. If the resistance of the arc should increase from any cause, the current passing through the solenoid would gain in strength, and the magnetic force overcoming the counteracting weight would cause the negative electrode to descend deeper into the crucible; whereas, if the resistance of the arc should fall below the desired limit, the weight would drive the iron cylinder within the coils, and the length of the arc would increase until the balance between the forces engaged is re-established.

Experiments with long solenoid coils have shown that the attractive force exerted upon the iron cylinder is subject only to slight variation within a range of several inches, which circumstance allows of a working range, to that extent, of nearly uniform action on the electric arc.

This automatic adjustment of the arc is of great importance to the attainment of advantageous results in the process of electric fusion. Without it the resistance of the arc would rapidly diminish with increase of temperature of the heated atmosphere within the crucible, and heat would be developed in the dynamo-electric machine to the prejudice of the electric furnace. The sudden sinking or change in electrical resistance of the material undergoing fusion would, on the other hand, cause sudden increase in the resistance of the arc, with a likelihood of its extinction, if such self-adjusting action did not take place.

Another important element of success in electric fusion consists in constituting the material to be fused the positive pole of the electric arc. It is well known that it is at the positive pole that the heat is principally developed, and fusion of the material constituting the positive pole takes place even before the crucible itself is heated up to the same degree. This principle of action is, of course, applicable only to the melting of metals and other electrical conductors, such as metallic oxides, which constitute the materials generally operated upon in all metallurgical processes. In operating upon non-conductive earth or upon streams of gases, it becomes necessary to provide a non-destructible positive pole, such as is supplied by the use of a pool of fused platinum, or iridium, or by a plumbago crucible. In working the electric furnace, some time is taken up in the first instance in raising the temperature of the crucible to a considerable degree, but it is surprising how rapidly an accumulation of heat takes place. In using a pair of dynamo machines capable of producing 70 webers of current with an expenditure of seven-horse power, and which, when used for purposes of illumination, produce a light of 12,000 candles, a crucible of about eight inches in depth, immersed in a non-conductive material, has its temperature raised to a white heat in 15 minutes, and four pounds of steel are fused within another 15 minutes, successive fusions being effected in somewhat diminishing intervals of time. The process can be carried on upon a still larger scale by increasing the power of the dynamo machines and the size of the crucibles.

The purely chemical reaction intended to be carried into effect within the crucible, might be interfered with through the detachment of particles from the dense carbon used for the negative pole, although its consumption within

a neutral atmosphere is exceedingly slow. To prevent this I have used, both in this connection and also in the construction of electric lamps, a water pole, or tube of copper through which a current of water circulates, so that it yields no substance to the arc. It consists simply of a stout copper cylinder closed at the lower end, having an inner tube penetrating to near the bottom, for the passage of a current of water into the cylinder, which water enters and is discharged by means of flexible india-rubber tubing. This tubing being of non-conductive material, and its sectional area small, the escape of current from the pole to the reservoir is so slight that it may be neglected. On the other hand, some loss of heat is incurred through conduction, with the use of the water pole, but this loss diminishes with the increasing heat of the furnace, inasmuch as the arc becomes longer, and the pole is retired more and more into the crucible cover.

In the experiments which I shall now place before you, the current which has supplied the one electric lamp in the centre of the hall will be diverted by means of a commutator through the electric furnace. After it has been active for five minutes to warm the crucible, I shall charge it with 8 pounds of broken steel files, which I shall endeavor to melt and pour out into an ingot mould before your eyes.

By some obvious modifications of this electric furnace it can be made available for a variety of other purposes where intense heat is required combined with immunity from disturbing chemical actions. By piercing a number of radial holes through the sides of the chamber, and introducing the ends of wires through the same, an excellent means is provided of heating those wire ends very rapidly, without burning them, for the purpose of welding them together. The electrical furnace will also be found useful, I believe, in the hands of the chemist, to effect those high temperature reactions between gaseous bodies which require the employment of temperatures far exceeding the hitherto available limits, and will thus increase the area of available reactions at his disposal for the attainment of either scientific or practical ends.

I have endeavored to compress within the limited space of a single lecture subject-matter that might occupy the close attention of the student for weeks or months, and I may, therefore, be pardoned if I have failed to convey to you more than a very rough outline of what may be accomplished by the judicious use of gaseous fuel and of the electric current as heating agents. The one purpose that has been foremost in my mind, in preparing this lecture, has been to make war upon the smoky chimney, which, so far from being a necessity under any circumstances whatever, should be regarded only as a remnant of that stage of our industrial and social progress which, satisfied with the attainment of certain ends, could afford to neglect the economical and sanitary conditions under which those ends were accomplished.

The exhibition which has been lately held in this city, of appliances for heating and illuminating by means of gas and electricity—in which your President, my esteemed friend, Sir William Thomson, took so prominent a part, as he does in everything tending towards the advancement of human knowledge and well being—proves how deep is the interest felt amongst you in the very questions with which I have had to deal this evening. And so I thought you might not be disinclined to give attention once more to a particular view of the question, which happens to be the result of the independent labor of one who may claim at any rate to have given a life-long attention to the subject.—London *Journal of Gas-Lighting.*

The Petroleum Outlook

The condition of things in the producing region has somewhat changed since our last report, and as we view it, for the better—at least so far as better prospective market prices are concerned.

The production has shown a decline of a trifle over four thousand barrels per day. The older parts of the field are exhibiting unmistakable signs of weakness, and the only remaining "rich streak," which is known as the Moody tract, within the defined area, has, in the opinion of many of the operators, clearly had the "cream taken off of it."

While the shipments from the region have been exceedingly small and the runs into the pipe lines have been exceedingly large, we are inclined to regard this, to a considerable extent, as artificial; and as an indication that the largest refining interest has thus used its control to make a weak market for crude, in order that that interest may acquire larger ownership of the crude stock. Such a course is made feasible by the ownership, by the refining interest, of the principal pipe line in the region.

This being the dullest season of the year for the refined trade—sandwiched as it is half way between the closing of the home trade and the opening of the export trade—an excellent opportunity is now offered to, and to all appearances, embraced by the refining interest of absorbing excess stock of crude. As quite a large new refining capacity is about completed in different parts of the country, and as the railroads, as well as this new refining capacity, are likely to make competition for the coming season, it is obvious that a control of the crude stock will give to the interest holding such control a large command of the trade—a leverage with which that controlling refining interest may make profits for itself while unmaking profits for its antagonistic competitors. This can easily be done by making the crude market uncertain and speculative.

The visible stocks of refined in the several European ports have become so reduced as to be altogether inadequate, and we are advised upon trustworthy authority that the stocks distributed in the interior have decreased considerably and are now very meagre.

Estimating the trade of the present year by the past, we may predict that an average of 55,000 barrels of crude per day, for the year, will be required to supply the demand, and should the production continue to decline at the present rate we will be drawing on our stocks before the end of the season. —*Stowell's Petroleum Reporter.*

Work for the Summer.

The London *Journal of Gas Lighting*, of March 15, 1881, in some editorial comments upon the subject of alterations and repairs to gas-works plant, which are usually effected during the comparatively dull time of the summer season, contains some passages which would appear to be applicable to every gas works in this country.

After speaking of the danger of falling into the habit of reproducing in stereotype the old arrangement of furnaces and retort settings, and reminding the gas managers of the experiments which had been so carefully carried on for some months, at the South Metropolitan Gas Works, and which experiments were very minutely described by Mr. Livesey, at the last meeting of the British Association of Gas Managers, the writer sums up the situation in the following manner—

"In these times no faithful gas manager can afford to wilfully neglect any innovation which promises to benefit the industry with which he is connected, and for the continued prosperity of which he is to some extent personally responsible. It is unnecessary here to enter into any fresh argument as to advantage or otherwise of regenerative gas retort firing. What we have to do is to put it to every gas engineer whether he has, in a manner consistent with his own responsibility, quite made up his mind either to try the system referred to, or to have nothing to do with it. Every one has an indisputable right to his own opinions upon this as on any other debatable question. If a man says he disbelieves in the new departure, and can bring forward valid objections to it, based on his own observation or experience, he is to be respected; and if he is in error, it is possible to convince him of his mistake. There may be another class of men, with perfectly fossilized notions, who have no other objection to fall back upon than their own *vis inertiae*. We do not pretend to argue with these hinderers of progress, if any such there be. We wish more particularly to reach those managers who would perhaps say they have heard or read something about the new style of furnace, but have not seen any in action, or do not think them suitable for their own purpose. To these hesitating or half interested gentlemen we would say—try them yourselves. Every gas manager who means during the coming season to pull out a setting of old retorts and replace them with new, has it in his power to try some simple generator like that in use at the Old Kent Road, or to improve upon this model. At least an attempt should be made to do something of the kind, and if the wishful experimenter is, by superior force, debarred from the fulfilment of his desire, the fault of inaction will not lie at his own door.

"It may be said that what can be done by way of experiment in a large London works cannot be copied in small establishments. In reply to this it need only be remarked that experience of the relative professional activities of the managers of large and small works rather points to the superiority of the latter. The multifarious duties of the engineer of a great establishment really militate against his chances, even with his considerable material advantages, of carrying out to the full a laborious investigation in any one branch of his official duties. If all difficulties arising with themselves are first overcome, it is very unlikely that those who may wish to advance this or any other promising class of research will meet with insurmountable external obstacles. Now is the time to commence a general effort to follow, perhaps to surpass, Messrs. Siemens, Oechelhauser, Schilling, Liegel, Livesey, and the rest; or to prove them in error, and prevent their opinions from spreading. It has come to this—If generator firing is to be the universal practice, advantage cannot be taken too soon of the annual reconstruction and extension of retort-settings, in order to introduce it gradually, and with all due precaution; if, on the contrary, the rising school are wrong let as many independent trials as possible be made to demonstrate the fact. But we believe they are not wrong, and that those who follow them in principle, if not in detail, will by so doing find benefits which we will not now enumerate. Therefore, let not all our professional readers stand looking at the direction posts until all the world shall have passed on before them."

[Official Report.—Continued from page 130.]

Eleventh Annual Meeting of the New England Association of Gas Engineers.

Held at Boston, February 16th, 17th, and 18th, 1881.

Second Day—Morning Session.

The Association met at 10 A.M.

On motion, the reading of the minutes of yesterday's session was dispensed with.

THE "STANDARD" SCRUBBER.

The President—I alluded yesterday to the scrubber which is in use at the Newport works, and as some of the gentlemen have desired some details in regard to it, I propose to give you the result of our working from Friday morning until Tuesday.

This scrubber is known as the "Standard." It has been in use in England for two or three years—my statistical friend, Major Dresser, says for four or five years. From the reports of its working there, I should judge that it had been very successful indeed. It consists of a number of chambers, in each of which revolve quite a large number of compact plates, separated from each other by little indentations. The space between the plates is not more than the eighth of an inch. Of course, the manner in which the plates are put together makes a very large surface, which is kept constantly wet by the revolution of the plates through the water in the bottom of the chamber. The plates are all attached to a shaft, on the end of which, outside of the scrubber, is a driving wheel, and an engine of about 1-horse power is required to revolve it. Each chamber has a surface of 1,344 feet, or a total in the four chambers of 5,376 feet. We started at 8 A.M. Friday, Feb. 11. All of the chambers were then filled with fresh water, and no water was run in again until Monday morning. At 9 A.M. on Saturday the liquor was drawn from the first chamber at a specific gravity of 63, and when cold 60, and showed 3° Twaddle, or 6-oz. liquor. The acid test gave 4.62 oz. In order to see whether there was any more ammonia than the acid test gave, I distilled it in a small flask with caustic potash; and the distillation gave 5.5 oz.—being a little lower than the other indication. On Sunday morning the liquor from the first chamber, at 65° F., gave 8 oz., and acid 8.56. The engine stopped Saturday night, and the man in charge did not know what was the matter, and let it stop; and so we did not get quite so good an indication that day. The total gas passing through up to 2:30 A.M. was 138,000 feet crude gas. The scrubber took out the ammonia very thoroughly indeed. The third chamber showed no ammonia—the second chamber took all that the first chamber passed. The very small quantity indicated by the saturation of the water showed that a considerable portion of the ammonia must have been taken out of the gas by our friction scrubber before it reached this water scrubber. The works were stopped all day Sunday. We had gas enough to give the men a holiday, and they banked up the fires. On Monday morning the indication was 5.50°, equal to 11 oz.; and the acid test gave 11.49 oz. We then turned on the water, and it ran at the rate of 3 gallons per hour, or 1 gallon per 1000 feet. The temperature of the water used was 57° F. On Tuesday we made another test, after 68,000 feet more of gas had gone through. The water was running a little faster than 3 gallons per hour, and the quantity used was 1.25 gallons per 1,000 feet. The indication was $6\frac{1}{2}°=13$ oz. The acid test gave 12.83 oz. At that time the gas was quite clean at the third chamber, and there was still another chamber to take any ammonia that might escape through. The gas that came through was absolutely free from ammonia; and it was evident from the water that was running in that the liquor was actually gaining strength all the time. I am hopeful that with increased strength of liquor we shall find that the subsequent purification by lime can be made more effective. I have always found that when we worked our liquor up to a pretty strong point we got better results from the purifier, on account of the aggregate quantity of acid that would be taken out.

Mr. Greenough—How much ammonia is in your gas before it goes into the scrubber?

The President—I do not know; I have not made any test of that. In the limited time of running I did not have a chance to attend to that. I think that our friction scrubber or condenser takes out considerable of the ammonia, although I do not think it takes out anything like the half of it. When we are using no water in that friction condenser, the ammonia is probably taken out to some extent by the condensation of the water that is in the gas. There is considerable condensation, judging from the ammoniacal liquor that comes from the water itself. The suggestion has been frequently made to me, in relation to this Standard scrubber, that it would be likely to stop up with tar. It would seem quite probable that that would be the case, on account of the close proximity of the plates to each other; but I found that the liquor that came from the scrubber appeared to have all the tar that was condensed with it, or the light oils, in a finely divided state. The constant agitation of the water seemed to prevent the tar from settling and condensing at the bottom of the chamber, and all of the contents appeared to be homogeneous. Just as much tar came from the top as from the bottom of the chamber. All of the liquor seemed to be in precisely the same state. I had anticipated that after two or three days' use the bottom would show almost clear tar from the settling; but I found that there was no indication of settling at all. After filtration, the ammoniacal water was of a very clear brown color, and the amount of tar that was left in the filter paper was very small, comparatively; and there was quite as much soot or tar in a finely divided state, so that it appeared to be nearly dry, as there was in the oily matter that appeared to stick to the paper. After the paper itself was dry, you could rub off a great portion of the tarry matter that lay on the surface of the paper, while there was some tar that remained in the paper that was a little oily. I feel very much relieved as to my appprehension of the scrubber clogging. I think it quite probable that the constant revolution, and the circulation of the water through the chambers, will keep them tolerably clean for a very long time.

Mr. Nettleton—Is not the most of your tar removed by your friction scrubber?

The President—We have a tar scrubber in the retort house, and when that is in action it takes out a very large portion of the tar. Still there is considerable tar that condenses afterward in the friction condenser. In warm weather there is tar still beyond that in the bottom of the purifier. The gas enters immediately from the hydraulic main, passes through the hot scrubber, and escapes from it at a temperature of 110° to 135° F. Notwithstanding that high temperature, the friction of the scrubber takes out a great deal of the tar. Then the gas goes on to another friction condenser, at a temperature of 118° or 119°; in the summer time the temperature is considerably higher than that. It is reduced down to as low a temperature as that of the air on escaping from the friction condenser. Still, we found last summer that there was a good deal of light tarry matter in the bottom of the purifier.

Mr. Lamson—Do you draw it or push it through? Is it before or after the exhauster?

The President—After.

Mr. Lamson—How much additional pressure does it take?

The President—In the amount of gas that we are making it requires no additional pressure.

Mr. Greenough—How much is that scrubber calculated to pass?

The President—250,000 feet per day.

The Secretary—Do you dispose of the ammoniacal water?

The President—No; we have never disposed of it. We have a promise of having it all taken at a fair rate if we can supply a standard 10 oz. or 12 oz. liquor.

Mr. Allyn—What is your idea of using your hot scrubber?

The President—The primary idea is to increase the candle power. We maintain the heat in this chamber or zig-zag scrubber, and while it is still hot take out the heavier tars from the gas before condensation. The theory that we have in connection with that zig-zag scrubber is that if we can take out the heavier tar while the gas is warm, the precipitation of those heavy tars does not carry along the higher hydrocarbons that are precipitated with the heavy tars under certain conditions, and which contribute in some degree to the lighting value of the gas, and which, if allowed to remain in, would be carried forward by the gas. We found that whenever the temperature of the zig-zag was reduced, as when in the winter time we omitted to put in the steam, or the gas escaped from the scrubber at a low temperature in consequence of the low temperature of the surrounding air, that the candle power of the gas would be reduced from one to two candles. When we maintained the heat, that condition of things did not exist. Then we found that it was impossible to maintain the candle power of the gas without a great addition of cannel coal, in consequence of the low temperature of the gas when it escaped from the hot scrubber. It seemed to scrub all of the light hydrocarbons out of the gas; so we discontinued the use of the hot scrubber until we could case it up in wood and preserve the heat in it. Then we turned the gas on again, and found that the condensation of the light hydrocarbons did not take place any more.

Mr. Harbison—What candle power do you send out?

The President—Between 18 and 19.

Mr. Harbison—How much cannel do you use?

The President—About ten per cent., running up to twenty per cent. in the winter time.

Mr. Stiness—With what yield?

The President—My yield last year was 5.18.

Mr. Allyn—Do you find any difference in candle power between the works and the office?

The President—I never made any accurate experiments to ascertain that.

We have a bar photometer and a jet photometer at the office and a jet photometer at the works. We take the gas daily at the office, and twice a day at the works. I have a general impression that the month's average between the two places would not vary very much.

Mr. Allyn—I have been using petroleum for the past year or so as an enricher, and I find that it shows a difference of about 1½ candles between the works and the office—a distance of about 2 miles.

Major Dresser—Which was the highest?

Mr. Allyn—It did not increase any. (Laughter.)

Mr. Harbison—Where does it pick up that petroleum—in the drip?

Mr. Allyn—No; we do not find any trace of it at all.

Mr. Nettleton—I would like to mention a fact in connection with my works. Last summer I put up a hot zig-zag scrubber. There is a box 4 ft. long, 2 ft. deep, and 18 ft. high. That box was divided into sections by a partition, so that it made in reality two boxes, each being 3 ft square. Those were filled with wooden slats, something like window blinds. In the bottom of each one of those boxes was put 80 ft. of 1-inch pipe, and the steam is kept continually running through both of them. The gas goes in at one side, runs up and then down. Of course, the object of it is to remove the tar while the gas is hot, and thereby prevent the elimination of hydrocarbon vapors, and increase the candle power of the gas. The point that I want to speak about is the difficulty that we met with in obtaining a temperature which was high enough. This scrubber was built on the outside of the retort house and about 4 feet away from the end of the stack. Around it was put a 12-inch brick wall. In it are two doors, and a roof overhead. I first made a double roof, and put in two single doors; but I found on turning on the steam that I could not get the temperature up in ordinary cold weather of 30° or 35°, above 85° or 95°. I then put on another roof, making three roofs, with an air space between each, and double doors; and I found that this made a difference of five degrees, so that now my temperature runs from 95° to 105°. I think a mistake was made in not building the wall double. If that had been done. I presume that the temperature would have been very much higher. At all events, at the works in Newark, by building the works double, leaving three inches of air space filled with sawdust, they have no difficulty in maintaining the temperature at 135° without steam. I think that it is very desirable to keep the temperature up to 135° or above.

Mr. Lamson—How far is the steam from the boiler?

Mr. Nettleton—Perhaps seventy-five feet. The steam pipe runs under ground, and is protected. It is only about fifteen feet from the pipe that supplies the engine.

Mr. Lamson—But still it may be very wet steam.

Mr. Nettleton—It may be, but I do not think it is very wet.

Mr. Lamson—If it is only fifteen feet from the end of your retort, you cannot get the steam dry enough. Your steam is almost in a state of condensation.

Mr. Harbison—What is the result, with regard to the illuminating power, of the use of the hot scrubber?

Mr. Nettleton—I cannot positively say. I have not had time to make any definite experiment. I had proposed to myself to go into quite an exhaustive experiment on the subject—running it three or four weeks with and without the hot scrubber, and then taking an analysis of the tar and seeing if there is any difference in the amount of naphtha that the tar contains with and without the use of the scrubber.

Mr. Greenough—I have been glad to hear the statements that have been made about the scrubber and washer. I believe that it is a good washer that you, Mr. President, have got in your works. I have no doubt you will find it a very efficient one when you come to put more gas through it—more so than at present. I do not believe you will have any trouble from the clogging of those plates. But what I was going to say was not so much in reference to that as in reference to the general subject of condensation—the settling of the ammoniacal liquor. I think that if the gas companies will take hold of this thing they can get more money out of it than they have been getting hitherto. I suppose that almost any company who are in a position where there are easy means of communication with manufacturers can get at least ten cents per ton of coal carbonized, which was the ordinary rate offered for it a few years ago, and it is what we were offered when we put up our washers. I think it is worth more money than that. When we put up our washers we declined to sell by any such arrangement as that. We insisted upon selling by the strength of the liquor delivered—selling the hydraulic main liquor and the liquor which comes from the condensers. The hydraulic main liquor had a strength of ¼ oz., and the other liquor had strength enough to bring the total up to 3 or 4 oz. liquor. All the liquor from the washer ran to another tank, and every tank load of that is separately delivered. In January I was looking to see what the receipts of our company had been per ton of coal carbonized, and I was pleased to find that the receipts had risen to as high as seventeen cents per ton of coal carbonized.

The President—For the ammoniacal liquor alone?

Mr. Greenough—Yes, sir. I wish to call the attention of the Association to the fact that if the ammonia is sold by strength, and the quantity delivered is measured, instead of selling by the ton of coal carbonized, we can hope to receive nearly a cent more per thousand feet of gas than if we simply sell it by the amount of coal which we use. I think it is worth while to bear that fact in mind in case anybody else puts up a washer.

Mr. Stiness—Is there any ammonia left?

Mr. Greenough—There was none to speak of. That was in the month of January. I do not mean to say that we can average that by the year.

Mr. Stiness—If you received seventeen cents, did you not take about all the ammonia there was out of it? Can you increase the strength much more?

Mr. Greenough—No, sir; I think we have got to the limit of that, unless the price of ammonia goes up. In January the weather was cold, and the condensation of gas was very good. The gas went through the washer in a very satisfactory condition, and it resulted in the entire removal of the ammonia. When the weather is warmer you cannot get such results as that.

Mr. Stiness—Do you know what you get in summer?

Mr. Greenough—In the summer we cannot do as well as that. It is impossible then to get the gas to the water in proper condition as regards temperature.

Major Dresser—Have you made any calculation to see how many pounds of sulphate the amount of ammonia would yield per ton of coal?

Mr. Greenough—No; we have no means of ascertaining that. During the last year I asked a manufacturer about how much it was, and I do not think it is as large as has been got elsewhere from what I have heard. He did not give me the exact figures.

Major Dresser—What ought it to be theoretically?

Mr. Greenough—I do not know, except from what I have heard. My impression is, about 24 pounds.

Major Dresser—That is about all that you can get from our ordinary coals?

Mr. Greenough—In January we received seventeen cents per ton of coal carbonized, taking all the ammonia there was. If we can take it out during the rest of the year as we did in January, I guess we should get the whole of it.

The President—I think that the Standard scrubber, when used in larger works, where there would be a greater number of chambers into which the gas would go successively, would show a power of concentrating the ammonia to a very high degree. One of the certificates published in the last number of the *Journal of Gas Lighting*, given by a gentleman who is managing large works in England, states that owing to the difficulty occasioned by having ice in the river, they had been unable to procure barges for the transportation of their liquor; and hence it became necessary to concentrate their liquor to avoid accumulating it, and on that account they had reduced the water in the scrubber to a very small amount, and had been enabled to concentrate their liquor to a strength of 30 oz. So that if there is any value in the point of purification by the concentrated liquor, they must have obtained about the ultimatum of all the possibilities in the way of partially taking out the carbonic acid and the sulphuretted hydrogen.

Mr. Nettleton—Can you state the cost of the washers which you put in?

The President—I cannot do that exactly; I do not know what they will charge for them. This was an experimental washer. Mr. George Shepard Page has the agency, I understand, in this country for that washer; at any rate, we made a contract with him, and the Smith & Sayer Manufacturing Company made the scrubber. They made this with a great deal of difficulty, because they had to make machinery all the way through for their work; and with their manner of putting in machinery they made a great many changes from the English plan. In the English scrubber the joints were made rust joints all the way through; in this country we have a partiality for surface joints—face to face. The English joints showed that they were simply extensions, without being touched with a lathe, and were put together with a rust joint, which would be very unsatisfactory in the long run. We gave this company a contract in August, and were promised the scrubber in forty days after giving the order; but I have only just got it. So you will see that they have been bothering about it a good while. The foreman of the shop who had charge of building the machine put two of his fingers into the contract, which were not called for by any specification of mine. I do not know whether I shall have to pay for those fingers or not. I may be charged for them, perhaps, under the head of constructive damages. They made a new machine for indenting the plates; and it was the running of that new machine which caused the difficulty with the fingers.

Mr. Gerould—This must be a pretty large machine. I understand from Mr. Porter that it allows 1,500 feet of surface for each 1,000 feet of gas. Does yours furnish that much?

The President—I believe that the surface is 5,376 feet; 1,500 feet per 1,000 would be an allowance of 4,000 feet of gas per day.

Mr. Gerould—That is the way I was figuring it. It seems to me it must be a pretty large machine.

The President—Those are the figures which he gave me. He may have made a mistake about it. He said there were 1,344 feet in each chamber.

Mr. Gerould—He insisted upon it that he allowed 1,500 feet for each 1,000 feet of gas.

TESTING METERS.

The Secretary—For some time past I have been testing meters as I had opportunity, and I think that about 1,500 or 1,600 meters have been tested very carefully. I had intended to put the results of my testing in a tabular form, but my duties as Secretary were so onerous that I have not had time to finish it. I am very sorry that I could not bring the table here in perfect form, for I think it would have been very interesting. My impression is that the average of all the meters was nearly correct—that is, within the rate allowed by the State of Massachusetts. 2 per cent. either way, fast or slow. If there was any variation from the rate allowed by the statutes, it seemed to me that it was against the company. Consumers often complain that their meters measure too fast; but my impression is that they are about right. It is very important that our meters should measure correctly. Because the average of all our meters is correct (supposing such to be the case) that is no reason why one of our customers should pay for 50 per cent. more gas than he uses because there are a great many on the other side who pay for 50 per cent. less than they use.

The President—Do you mean to say that there are some that are 50 per cent. fast?

The Secretary—No; I am only stating it very strongly. I have known meters a great deal more than 100 per cent. slow, for they did not register at all.

Major Dresser—How do you get at the percentage in that case?

The Secretary—By intuition. (Laughter.)

Major Dresser—Did you have to bring that average in in order to arrive at the result that, taking them altogether, they are generally correct?

The Secretary—If we were to take the meters that do not register at all, and call them 100 per cent. slow, then the average would be against the company. I did not take that into consideration at all. A great many of the meters have ceased to register. It is very important that our meters should measure as nearly correct as possible. It is very agreeable when a customer finds fault with his bill, and asks that the meter may be tested, to find it correct. The State Inspector in his report has shown that the average of meters is a very small per cent. fast—over and above what the law allows; but it should be remembered that these are meters nearly all of which have been sent to the State Inspector for inspection because the consumers objected to their bills as being to large.

Major Dresser—In his percentage does he include those that do not register at all?

The Secretary—No, he does not; he says that so many are fast, so many are slow, and the average, fast or slow, is so much; and that so many did not register, and that so many are correct.

Major Dresser—I have noticed that it is a peculiarity of all inspectors' reports, that they do not take into consideration the meters that do not register at all, and consequently their statements, whether for or against the company, must be in error, by an indefinite amount depending upon the number and size of non-registering meters.

The Secretary—If any of the members have made tests of meters for some time, we would like to hear from them. It is a question with a great many gas managers whether it is expedient, whether it would pay, to have all the meters tested. Many of us have meters that have been in use for year after year, that have never been tested, and perhaps never will be, unless objections are made and they are taken down, and before resetting are inspected. Many of them have been set for a great many years. They may be wrong—they may be measuring against the company, or they may be measuring against the consumer. If any one has made such tests and can give us the result of his experience, we shall be very glad to hear from him.

The President—I thought I saw Mr. Harbison about to rise before Mr. Neal took the floor.

Mr. Harbison—It is always my case that whenever I attempt to say anything somebody else gets up and takes the wind out of my sails.

The President—You can now take a fresh tack and start again.

Mr. Harbison—It was the question of meter proving that rose to my mind at that moment. I think it is quite an important matter. Of course, anyone personally acquainted with gas engineers, particularly with New England engineers, knows that it would be a moral impossibility for a gas engineer to tell anything but the absolute truth; but the consumers of gas have not the same opinion of them in connection with meters, which these same engineers place in the house or office or place of business to measure the gas which they furnish. It may be that the makers of these meters are responsible for that opinion. We want, if we can, to satisfy our consumers of what we know and believe ourselves—that the gas meter is an accurate instrument for measuring, liable to slight variations at times, but those variations being almost invariably against the company. It appears to me that it is a matter of sufficient importance for every engineer to carefully consider how often it is best for him to test the meters which he has in use; to keep a careful record of his tests; to find out who makes the best meter, and to find out from practical experience what is the life of a meter. That is a very important question. Meters are expensive things, and are permanent investments. If they have to be replaced by new meters it adds largely to the running expense. How long is it best to run a wet meter, if any are still in use, and how long a dry meter? What conditions ought they to be worked under? So far as I am concerned, I would personally be very glad to hear from gentlemen of the Association year after year with regard to the result of this part of their business: their testing, under what conditions they test, whose meters they use, how long they have been in use, how often they have been tested, and the results of the testings. I think this information would be of very great value to gas engineers, and would go a great way toward enabling us to satisfy our customers of the correctness of the instrument we furnish to measure the gas we sell them. So long as the meter registers, and registers correctly, there is no disputing the bill, and no relief for them if they do dispute it. They must pay by the meter. We ought to be able to satisfy them that our opinion as to the correctness of the meter are based on good grounds, and that the instruments are what we claim them to be—correct instruments of record. I wish some movement could be inaugurated which would give us year by year this information in such form that we could compare notes in regard to it. It would be a very strong incentive to meter manufacturers to try to excel their present attainments in the perfection of the instrument which they sell us, and the accuracy of which we can only tell about after years of trial.

The President—I will state in this connection that for the last five or six years we have been trying to keep an accurate history of every meter set. It is quite difficult to do it, owing to the fact that meters are handled by different men, and by men who are changing from time to time their employ; but still, as resolutely and as successfully as we can, we are keeping a record. As Mr. Harbison tells us, it is a matter that involves a great deal of time. You cannot get up a history of a meter in a year or two. We have had meters in use for 16 or 20 years, and they are working very well to-day. We know very well that others give out in three or four years. I think that is largely owing to the location of the meter. We find by experience that where meters are placed in close proximity to hot furnaces they get used up very soon indeed; and there are other conditions which are somewhat against the durability of the meter. In our own case we take out a great many meters every autumn and set them again in the spring. We find that meters that are taken out and put by in that way and are allowed to remain idle a large part of the year, are destroyed very much sooner than those which are in constant and steady service. That is a condition of things in our town which we cannot avoid. As soon as they are taken out we put rubber stoppers in the inlet and outlet, which are not displaced except for the purpose of testing. We try to keep the gas that is in them in them all the time, although it gets out by the process that chemists tell of—the displacement by each other of gases of different specific gravity. In a year or two we shall be in shape to give quite a history of our meters. As I said, the life of a good meter is about 16 years on the average, and it is therefore pretty difficult to write the biography of a meter until after its death. The process of keeping a record of meters is quite simple, but it is simplified very much in the case of companies whose customers are not in a transition state all the time. In our case, of course, the labor of looking after meters is considerably augmented, and the labor necessary to keep a record is augmented in like proportion by the constant changing of our consumers. Where the business is tolerably steady, I should suppose that it would be a very simple thing, as well as a very instructive thing, to have a complete record of meters. Then we would know whose meter was the best, and we might be able to give our successors some information which would be of use to them, even if we did not live long enough to avail ourselves of it.

Mr. Cabot—So far as I know, the only company who have a complete record of every meter set since its organization is the Lowell Company. My impression is that they have a complete history of every meter since the organization of the company, and if Mr. Cushing is present I think he might give us some valuable information on that point.

Mr. Cushing—I guess that Mr. Cabot is under a misapprehension in regard to that matter. When our company first started we did keep such a record, and we have got a very large ledger filled with the numbers of old wet meters and their history. After the dry meters came into use the record was discontinued, and we have now only got our meter books. We could get from those meter books quite an amount of statistical information which would, of course, be very valuable; but it would be the work of years to get it together.

Mr. Slater—We have been in the habit, during the past six or eight

years of testing from 2,500 to 5,000 meters per year. I have not got the exact facts with me, and can speak only generally about it. In a large majority of cases the tests have resulted in favor of the consumer. Some of them have been in favor of the company. Anyone who has given the subject any attention can judge of the comparative difference between accurate measurements of gas as compared with anything else sold in the market. It is well known that where they have laws requiring the testing of meters the requirement is that they shall be within two per cent. either way. Within two per cent. is considered sufficiently accurate with gas. If you take the case of brandy, at $20 per gallon, a thousand cubic feet of brandy would be equal to 7,500 gallons, and two per cent. variation either way from strict accuracy would be $3,000. Or take molasses; the same variation in molasses would be equivalent to $60 per thousand cubic feet. If gas is sold at $2.25, two per cent. variation from that amounts to only 4 cents; if it is sold at $3, the two per cent. variation amounts to only 6 cents. So that although the meter does vary slightly one way or the other, the comparative money value is small when considered in comparison with anything else.

Mr. Harbison—I would like to inquire of the scientific gentlemen of the Association, like yourself, Mr. President, Mr. Cushing, and Mr. Slater, who have given this matter careful attention—and from the other scientific gentlemen in the room whose names are too numerous to mention—what their custom is in regard to testing meters: whether they bring their scientific knowledge to bear in testing meters as they do in making chemical analyses; what their custom is in bringing a meter from a customer to be tested in cold weather; do they put it right on to the prover and test it without regard to temperature? do they vary the rate per hour at which they burn the gas according to the size of the meter? I ask for the sake of general information. It seems to me possible that all of the members of the Association may not be posted with regard to the modus operandi in the testing of meters. I would like to know from the gentlemen who have studied up this subject what the general practice is.

Mr. Slater—It is hardly to be supposed that any gas man would bring a meter in for testing when the mercury stands at zero and test them at 80 or 60 degrees. Anyone who has had any experience in the testing of meters will look to the temperature as well as to the other conditions.

Major Dresser—I will state a fact that came to my knowledge in this connection. The point that Mr. Harbison made is of some consequence. I have no doubt that, so far as you manufacturers of gas are concerned, you watch your thermometers closely; but I know of a case where attention was not given to the temperature. The consumer complained that his meter was wrong. The company took his meter to their own shop, tested it, and found that it was correct, or within the limitation of the law. It was put back. The consumer did not believe that the meter was correct. He was not satisfied. He was told to take it to the public inspector and have it tested. It happened at a time when the mercury was in the neighborhood of zero. The meter was put in a wagon, driven a mile or two to the inspector, and the consumer wanted to have it tested right off, then and there. He wanted to see it done. The inspector accordingly put the meter right on to the prover, and gave the consumer a certificate that the meter was wrong. The consumer then went back to the gas company in triumph and said, "Now I have got you, gentlemen; here is a certificate from the inspector, showing that your meter is so many per cent. out of the way." This rather startled the gas company, but they sent for the inspector and the meter. They made an arrangement with the inspector to come the next day and test that meter. In the meantime they sent another meter to the consumer's premises and brought the one that was in question to their own works and put it on the shelf. The next day the inspector came around, saw the test made, and was perfectly well satisfied that the test of the gas company was accurate and correct. He was very much astonished that he should have given a certificate that the same meter was in error. He had forgotten his thermometer. In reference to the manufacture of meters, there is one thing that must be borne in mind: the makers are not responsible for the accuracy of their meters where there is an inspection law. No matter how accurate they may be, it is the inspector who must test and seal the meter. The public inspector, where there is one, is alone responsible for the accuracy of the meter, no matter who the manufacturer may be.

The Secretary—I have not the State Inspector's report with me. I alluded to it, and stated that I thought the meters that were sent for inspection were a fraction slow. I may not be right. I would like to have Mr. Hinman give the result, and state how many meters were tested.

Mr. Hinman—Last year 122 meters were tested. Forty-eight were fast; the average was 4.54 fast. Fifty-two of them came within the two per cent. of the law; I think they averaged a little bit slow. The meters that were slow numbered 22, and averaged 6.59 per cent. The total average of the 122 meters inspected was 0.52 per cent. fast.

The Secretary—Those meters were sent to you by consumers who complained of them?

Mr. Hinman—Generally.

The Secretary—Some meters do not register at all.

Mr. Hinman—Certainly; there did not happen to be any of that kind last year.

The Secretary—When there is, how do you get at that?

Mr. Hinman—I take those out of the report. Of course, when they do not register at all we cannot put them in an average.

Mr. Stiness—That would make your general average much heavier. You count them in the number of meters that are inspected, do you not?

Mr. Hinman—Yes.

Mr. Stiness—Suppose you inspected 152 meters, and that ten would not register; would you count them in?

Mr. Hinman—I should report that the average of the 142 meters that registered was so and so, and that 10 meters did not average at all.

Mr. Stiness—I would like to inquire whether the number of meters that do not register at all is stated in the report of the State Inspector. It seems to me that where a report has gone out that 142 meters register 0.52 per cent. fast, the fact that 14 of those meters did not register a single cubic foot should be stated in a foot note.

Mr. Hinman—Last year I did not have any such, and therefore they are not referred to in the report. In former years I have had such, and I stated the number.

Mr. Stiness—There is one matter in regard to meters that has always struck me, and I have endeavored in my own business to change it as much as possible. We were speaking a short time ago in regard to the record of meters. I think that the Providence Gas Company, with which I was connected some eleven years ago, have a record book containing the particulars of every meter set, of its removal, and everything of that kind. In the year 1869 I prepared a book, and from that day to this every meter that has come into my office and every meter that has gone out has been placed upon that book. The size, number, and index are taken of every meter that goes to be repaired, and when it is returned the size, number, and index are again placed upon the same book. I can trace for eleven years the history of every meter that has come upon my premises or gone off, whether it has gone to the consumer or to be repaired, whether it is worn out or condemned, or whatever may be its state. The location of the meter, with regard to the consumers finding fault with their bills, is, I believe, one of the great causes of trouble. I remember that a few years ago Col. Stedman told about a remark which he made to a customer who came into the office and complained about his bill. It is the same old story over and over again—as we had it in the last number of the American Gas Light Journal. The consumers do not believe in the meter. They know nothing about it; they consider it an infernal machine. Why? Because it is a very imp of blackness itself. There is where it gets its bad name. I believe, with the intelligence there is in the business of the manufacture of meters, that the manufacturers of this country could get up a meter that would be a thing of beauty; so that by its very beauty people would be compelled to take it from its present location. And where is that location?

Major Dresser—It is in the coal hole.

Mr. Stiness—Yes; it is in the coal hole and in the companionship of the scullery maid. The architects are more to blame than anyone else. Can you find me an architect who knows enough to inform the builder where to locate the gas meter? No attention is paid to this in ninety-nine cases in a hundred. The architect goes on and draws beautiful plans of a building and sends them to the gas company. The first question we ask them is, "Where have you located the meters?" "They will come in by and by; I do not know where they are." Perhaps they will be stuck in the hallway, or in a closet out of the way. In private houses they are often put in the cellars, where nobody sees them. I believe that if the form of the meter were changed, or its covering beautified, so that we could bring it up where the consumer could see it and could read the index day by day and week by week, and know the amount of gas that was being consumed—that then we should not have one half the trouble with complaints about exaggerated bills and mistakes in the taking of indications, and everything of that name and nature which goes to make up the life of a gas man. I am not myself so much annoyed as I hear others are; but occasionally there does occur a case of complaint, and sometimes a man will say to me, "Why cannot my meter be brought up where I can see it?" I reply that I will bring it up. I remember another case where a man said to me, "I do not want that —— thing in my entry,"—because it was black. I believe that if the architects would take more trouble to locate the service pipes and the uprights of the meter, and if we could have an instrument which we should not be ashamed to place in any part of our houses, the consumers would become more accustomed to it, and would not call it the imp of blackness that it is, or a mysterious machine that they cannot understand; and that thereby our troubles would become very much lightened. I think that the matter of keeping a record of meters is one of the most important things that can be done. It should be such a record as would enable you to trace a meter

from the time it arrives at the company's office from the manufacturer until its death.

Mr. Allyn—I am reminded of the trouble that my friend Spaulding had with a consumer whom he found using the gas not only for illuminating but for heating his house and doing his cooking; and I think the details of that case will prove interesting to the Association.

Major Dresser—I would like to make a remark before we go to the heating business. It is in furtherance of the idea which Mr. Stiness has suggested. There is a city in the West where the gas company, or the officials of that company, look out and remove their meters from the exclusive society of the scullery maid, and bring them up where the rest of the family can enjoy them. In all the new houses that are constructed in that city a nice little niche is prepared for the meter in the front hall. A little door or panel of glass covers the niche, and behind this the meter is placed. As the gentleman of the house goes out in the morning he can see exactly how much gas he burned the night before. It is a very simple arrangement, and can be adapted to any place. I think if that system was universally adopted it would remove a great deal of the unpleasant conversation that goes on at the time people come in to pay their gas bills. At any rate, it would enable the gas officials to quietly ask a gentleman if he had taken a daily note of the amount of gas he was burning—which is sometimes a very pertinent question.

Mr. White—As you have entered upon the æsthetic question, I would like to approach the subject with proper deference. If the gas companies throughout the country are anxious for a meter which shall be a thing of beauty as well as of utility, I will state that a certain meter manufacturing company (the name of which I need not give) will agree to place meters in ornamental cases so attractive that they may become mantel ornaments, and be surrounded, if you please, by a jet photometer. Instead of a statute of Pizzaro discovering the Pacific Ocean—something in this position—looking out over the boundless Pacific, I think it would look well to have Pizzaro standing in *this* position, with a Jones jet, for instance, in his hand. Then we can look upon the beautiful machine keeping a record of the gas we may burn, and also see the illuminating power of the gas duly recorded. As a gas engineer, I have found that it was a sensible thing to divide my town up into three districts, and make it a rule to bring in every meter from a district within a year, testing it and putting it back; so that within the three years I go entirely around the districts and test every meter. I claim that no meter should be allowed to remain in position over five years without an inspection. Owing to local surroundings, a meter perfect in itself at the time of its setting, and without fault of any kind, may become either fast or slow within a short time. By taking the meters out, making accurate tests of them, and keeping a record of them and of your tests, you are able to classify the local disturbances. When I took charge of the Citizens' Gas Company of Brooklyn I found that many meters had been in position for nearly twenty years. During all that time they had never been taken out; and the leakage of that company at that time was something enormous. I found that a large proportion of that leakage was due to these meters; that the meters were running in all directions, but largely against the company. They were nearly all dry meters—some few were wet meters. The older ones were of course wet meters. I found after I had gone around (and I did not take three years to get around), and had tested and inspected all these meters, I was able to reduce the leakage from that source alone 10 per cent. You can imagine what the total leakage of that company must have been when I tell you that I thus saved ten per cent. of the leakage to the company. I think that other companies—and particularly older companies—would find it to their advantage to do the same thing. When I left that company they had a record of every meter that was out measuring gas. Whether that record has been kept up since I left I do not know. It was certainly a very interesting study. I derived some very valuable suggestions from that record, and I have been endeavoring to impart this information from time to time to gentlemen as I have met them. I do not think that any careful gas company can afford to run their meters without very thorough and frequent inspection.

Mr. Slater—Mr. Harbison was speaking about the local surroundings as affecting the meter. We have found meters that have been in use for ten or fifteen years, but which when tested proved accurate. We have found others which have been in use for six months or a year only that tested inaccurately. These are meters of various makers.

The President—Did you notice the local conditions—as to proximity to the furnace?

Mr. Slater—There were no facts that would lead us to think that there was any reason for the inaccuracy in the local conditions.

The President—We have taken out meters several times where there was complaint of their being too fast, and we almost always found that we could trace the connection between their running fast and their proximity to the furnace or to some source of very high heat. Several times we have changed the location of the meter. We have taken out a meter that we found was suffering from too high a temperature and located it somewhere else, and then all difficulty ceased. I think that Mr. Goodwin will bear me out in the statement that there is a disadvantage from high temperature aside from the fact that a high temperature expands the gas and makes the meter measure faster on that account. A high temperature also has a tendency to harden the leather, to stiffen the valve in the meter, and on that account makes them less accurate. At one time we took out a meter which was 20 per cent. fast. I think that is the highest test we ever had of a meter running fast. It was because of the condition of the diaphragms and of the interior movements of the meter. I will say, however, that that registration was after the meter was taken out, and not while the gas was passing through it in the consumers' house.

Mr. Harbison—The reason I brought this up in the way I did was because I think that gas companies generally are suffering greatly from a lack of information on this subject in their own places. We send our man out to bring in the meters, and personally we know nothing about their location or their surroundings. In testing the meter we are very apt to decide without any further information as to their accuracy. If we were to keep an accurate record in regard to all these meters, we will be better able to discover the cause of the inaccuracies as existing in the local surroundings. If we find a meter running 10 per cent. fast, and set another meter in its place, and then when we test the second meter in six months or a year, find the same condition of things, we will then, if we are attending to our duties, look for the cause. If we have no record of meters the fact will escape our attention or we will know nothing about it. The same thing may then be repeated from time to time, greatly to our own annoyance and to the injury of our customers. If we keep a record, and notice carefully the discrepancies, our attention will then be called to the surroundings, and we will at once see the propriety of taking measures to overcome the difficulty, and will be able in the end to secure very flattering results.

STEALING GAS.

The President—It has been intimated that Mr. Spaulding can give an interesting statement of an experience of his in the detection of a party who has been in the habit for some time of using gas that he did not pay for.

Mr. Spaulding—I was not aware that I was to be called upon, but I am willing to impart such information as I have with regard to the stealing of gas. I found a party in our district who was using considerable gas, and I found it out in this way: It is well known by all gas engineers who reside in the immediate vicinity of Boston that last season the Boston Water Works laid in a 48-inch pipe through Brookline—laying it in close proximity to our gas pipes for two and a half miles—running from the Chestnut Hill Reservoir to the Mill Dam. During the season we had several breaks in our main pipe, which cut off all the supply of gas on Beacon street. Every time the pipe would break, a mile or two back from the section where we discovered the leakage we found that the air was taken into the pipe from some cause or other, at some point or other, we did not know why or where; and I made up my mind, of course, that there must be a break in the pipe. Whenever this pipe was broken on Beacon street the gas would immediately escape, and its place would be supplied with air. I knew this by the street lights all along in this section. I would have to run around, take off the caps, and blow out the air. Of course this led me to suppose that there was a leakage somewhere in that neighborhood. While hunting for it a gentleman came to me and asked me if we gave away gas to anybody. I told him that I did not know we did. He said he knew of parties who were using gas but not paying for it. I told him that I would like to know who they were, and he informed me. I went to the house. It was on Burlington avenue. I went there without making too many remarks, got a search warrant, and went into the house. I found that they were using, in their cooking stove (in which they had five round burners), and in two large heating stoves, a supply of our gas sufficient not only to do their cooking, but to heat their house. Of course, when the main broke, they knew nothing about it, and the break would draw in the air through all the burners in the house, and so the air would fill the main pipe. As soon as I made this discovery I called upon the State Inspector to test the stove. We found that they had burned a great deal of gas. They had used gas for lighting, cooking, and heating for three years and two months. We arrested the gentleman, brought him before the courts, had a trial, and he was bound over. He is now offering us $1,500 in settlement of that gas bill. We find that he had burned over 1,000,000 feet.

Mr. Cabot—How long had he been burning it?

Mr. Spaulding—For three years and two months. He made the connection immediately after he went into the house. There was a party who moved into the house and boarded with him; and he supplied their room with gas and told them that it would not cost them anything. We have them for witnesses. It was a very interesting case. It helps me out on my leakage this year. I put it all into my leakage this year, and my directors think I have made a splendid showing.

Mr. Cabot—What else besides leakage did you find?

Mr. Spaulding—I found that he was a gentleman in every sense of the word. When he came up to the door I was pacing up and down in front acting as a sentinel at that time. It was very stormy when he came in from Boston. I asked him if his name was Jones, and he said it was. I said, "Have you been using gas here?" Said he, "No, sir." Said I, "I think you have." Said he, "Do you ever drink any thing?" Said I, "No, sir; I never do." Said he, "Won't you smoke?" I said, "I do not care if I take a cigar." Then he asked me in. Said I, "Would you like to settle this case now?" Said he, "What case?" Said I, "Burning gas." Said he, "I have not been burning any gas." I took his cigar and smoked it until I got my police around, and then, with the search warrant, I went in and found what I have mentioned in relation to the gas. He had a straight connection. We examined the house, and found in it about $600 worth of cutlery—pocket knives, etc., six or seven turkeys that had not been cooked, nineteen Dutch cheeses, ready-made clothing, a small quantity of boots and shoes, some cigars and liquor, and several other things. We made up our minds that there was considerable property there belonging to somebody else. I thought it best to attach this property, and did so; and for fear that somebody would come in and claim it, I took an $800 bond for the whole thing, and relinquished that claim. He gave a bond for $1000 to appear at court besides. His wife was a rather plain looking woman, but she was smart; she had traveled; I am told that she used to live on Lyman street. My lawyer said to him, "I should not think you would have burned the gas in that way—you were rather bold about it." Said he, "There are lots of people in Boston who burn it in the same way." I mention this for your benefit. We shall probably settle the case in a few days.

Mr. Greenough—When you settle with him I wish you would ask him who the "lots of people" are in Boston who burn gas in that way.

Mr. Harbison—I would like to ask Mr. Spaulding how he accounts for the air getting back into the main pipe through this particular service pipe from this particular house—any more than it would from any other house—simply because he had a break in his pipe.

Mr. Spaulding—They heated their house from cellar to garret with gas and their burners were all open. They did not know when the main was broken. Of course, when our main pipe broke it cut off their supply, and the gas escaping at the higher point would naturally draw in the air through their burners.

Mr. Harbison—Did they keep their burners going all through the day?

Mr. Spaulding—Certainly; for he had not bought any coal or wood in three years and two months.

Mr. Nettleton—I would like to inquire if the gas fitter who made the connection was not responsible to your company in case you saw fit to look to him?

Mr. Spaulding—Yes; we hold him responsible, and we have got him. It was the man himself. The meter had been removed the year previous, and was then erased from our books.

Mr. Harbison—How could that thing go on for three years and your men not discover that gas was burning in the house?

Mr. Spaulding—It was a Place—running in back from the street. Not more than half of the houses had been occupied; we had no consumers in there, and no one ever went in there unless he had business. That is one reason. Besides that—they were queer; the curtains were always down; the house was apparently closed; the neighbors knew nothing about them—never visited them; neither did they visit the neighbors. It looked as if it was a stopping place for rogues—a place for the deposit of stolen goods. I have no doubt that the woman herself, judging from what we found in the house, was a professional shoplifter.

Mr. Harbison—When the main broke did he complain of a lack of supply of gas?

Mr. Spaulding—Yes; when we were running around there blowing out the air he came out and wanted to know what the trouble was with the lights in the street. He felt very indignant to think that they could not be kept burning every night.

Mr. Allyn—Was the lady in good health when you first went there?

Mr. Spaulding—She was sick when we went in; she said she was feeling unwell just at that time.

Mr. Allyn—How long did it take her to disconnect those stoves?

Mr. Spaulding—She was just about 30 minutes from the time I called until she let me into the house. I went to the house, rang the bell, and said that we had got a leak outside somewhere. I had gone into the houses of two or three of the neighbors previous to calling there. Finally we went up to her door and rang the bell. I was told that nobody could get in. The neighbors said that nobody could get in without a pass word. I thought from that that she must be a mason. I did not, however, give any pass word. She raised the window above and stuck her head out. I told her that I would like to come in; that I was looking for a leak, and perhaps I could locate it somewhere in that section. She said she was very sick, and it was impossible for her to come down. I said that I was very sorry, and that if she would tell me where her husband was I would drive right into the city, and bring him out. She said she would not put me to that trouble; if I would wait half an hour she would dress herself and come down. I replied that I would wait with pleasure. During that half hour she disconnected the cook stove and threw the pipes into the wood box. She disconnected the service pipe—pulled the rubber hose off and shut off the gas. She stored these things around in different places, so that I could not see that she had been using gas, although I smelled it when I went into the house, and found that the house was still quite warm. I took one of my assistants with me and went down into the cellar, and looked around trying to discover the leak. I had my assistant go into another part of the house and ask her to come to him, so that I could get into the kitchen. While she was out I slipped into the kitchen, looked into the stove, and found that there was no grate there and no fire-brick, but the stove was hot. I was a good deal like the Frenchman—I mistrusted something. I asked her how she heated her house. She replied that she had been cleaning out her stove. I asked her where she put her ashes, and she said she threw them outside. I asked her where her coal was, and she said she though I was rather impertinent. I told her that it was my business to make such inquiries, and that I must find out where the leak was. She commenced feeling sick again right away, and then she went up stairs and would not answer any more of my questions. Then I sent out for policemen, got my search warrant, and before I left the place discovered the whole thing. She immediately had to send out and get some coal and wood, for it was growing cold inside of the house.

FINDING BREAKS.

Mr. Gerould—The last winter has been a very severe one with regard to breaks. I saw something to-day that perhaps many engineers have not thought of for use in finding breaks. When I was out at the Melrose Works I found that they had a little two-horse boiler mounted on wheels. I asked what it was used for, and they said that whenever they had a break in the street and the frost was deep, they drove that boiler to the place, and within an hour or two were enabled to thaw all the frost out of the ground; and in this way they could readily find the break without the extraordinary expense of digging up three or four feet of frozen ground. It seemed to me that it was a very good plan. I have ordered one for myself, and I think it is the cheapest way to find a break in the street. It is a two horse boiler with a pump attached. It can be driven to any place, the water can be pumped into the boiler, the steam started, a hole driven into the ground, a rubber hose pipe put into the whole, and the steam will take the frost out of the ground for 10 or 15 feet around. It is apparent that by its use a large amount of expense and time can be saved in finding leaks.

Mr. Allyn—I tried that experiment once. Before I left Brookline we had occasion to raise a 12-inch main, with 3 feet of frost in the ground. We tried nearly every device we could think of to see if we could not do our digging more expeditiously than with pick and shovel. Among other experiments we got an ordinary pile driving engine there. We got under the face of the trench, and through a hose directed the steam against the bank. We found that we did not accomplish anything. A man would dig out double the amount with a pick that we could work out with the steam. I had read of a number of cases where a steam boiler was used for taking the frost out of the ground, but we could not seem to make it work in our place.

Mr. Harbison—About what was the pressure of the steam in this boiler to make it effective?

Mr. Gerould—I do not know; I do not think it was a very high pressure. A hole was driven down below the frost, steam put in, and it took the frost out for 15 or 20 feet around. This was in a gravelly soil. The character of the soil might make a difference in the result.

Mr. Allyn—It might work in sandy soil, but where there is stone or hard concreting I do not think that it would have any effect.

Mr. Gerould—I saw them when they first started on this operation, and in an hour and a half they had 25 feet of street open.

The Association then took a recess until 2 P.M.

Second Day—Afternoon Session.

The Association was called to order by the President at 2 P.M.

THE PRESERVATION OF SERVICE PIPES.

The Secretary—I will suggest as a topic for consideration, the best method of preserving service pipes. My experience in this regard may differ from that of those who are away from the seaboard. At Charlestown there is considerable salt in many of the streets, which permeates through the soil and affects the service pipes, causing them to decay. In many cases we find them as thin as paper—so thin that the least touch will destroy them. I have no doubt that we now have a great many service pipes which are very much decayed, but so long as they are not meddled with they con-

tinue to hold gas. For two or three years I have been quite exercised on this subject; and I shall be very glad to hear from any of the members if they can state what process can be adopted to make them more serviceable—whether it can be done by dipping them in some substance such as tar or asphalt—or whether any kind of pipes can be used, other than are now employed, which will be more permanent. All of the service pipes now standing on our books are charged off and do not appear at all. I consider them perishable—perhaps more perishable than meters. The mains have been charged to the construction account until lately. The service pipes are considered to be of a more perishable nature, and require to be renewed quite often. I am aware that in some places lead pipes have been used for service pipes instead of wrought iron. It has been suggested that cast iron might be employed; but there are objections to the use of cast iron for service pipes—especially for small services. In some places I am told that the pipes are dipped in some substance which is said to make them more durable. I think that it will be necessary for me to take up and renew a great many of the wrought iron services in the lower part of the district which we supply with gas. If there is anything better than we are now using I would like to know it. In the use of lead for service pipes it is necessary, as I learn from those who have employed lead pipes, to lay them in a box in order to keep them on a certain plane to get the drip. The services for water are run anyway. It makes no difference whether there is a drip in them or not. But for service pipes for gas it is necessary that they should all drip one way, and run on an even plane. With lead pipes it is necessary to use some kind of wood for a box. That makes them more expensive, and the wood is likely to decay. I would like some information on this subject, as one of these days I shall have to renew a great many of the service pipes in my district.

Mr. Wood—I suppose that this is a subject about which we all want information. I will state how we have managed under similar circumstances. We have some streets which have been filled in with mud and are very soft. For those streets we have to dip our service pipes in coal tar. To do it we heat the services not quite to a red heat. We put the whole length of the service into a trough filled with thick tar—dip it right under, let it remain long enough for the tar to fully cover it, then take it out, and the heat of the pipe will set the tar so that it is like pitch upon it. In an hour or so it will harden so that it can be handled. We find that that helps to preserve them very much. I think, however, that there might be something better than that.

Mr. Allyn—I would like to ask Mr. Neal if he uses galvanized iron?

The Secretary—We use wrought iron, not galvanized.

Mr. Allyn—The Cambridge company formerly used plain pipes for services; but they found that they rusted out so badly that, of late years, we have used nothing but galvanized iron, and we find that that prevents corrosion and rusting in a great measure, although some of our streets are so thoroughly saturated with salt that it would eat away almost anything in the way of wrought iron.

The Secretary—Have any of the gentlemen present used lead pipe for services?

Mr. Cabot—I have not used lead pipes, but for the last few years I have used wrought iron pipes covered with a coating of red lead and have found that to benefit it. In England they have a process for laying their pipes in a V shaped block, with concrete in it, and then covering the pipe with a coating of concrete. That concrete becomes very hard and not only preserves the pipe, but, if the pipe should corrode, it forms of itself a passage which is very durable. We have not a great deal of soil that is likely to be saturated with salt water, and have not, therefore, had a great deal of trouble with pipes giving out; but for the last six or seven years I have adopted the process of covering pipes with red lead.

The Secretary—There is another kind of soil which is very injurious to pipes, and which is found away from the seaboard; I refer to filling, as with ashes. I am told that that is very injurious to wrought iron pipes—that they oxidize very rapidly in that kind of soil.

The President—We have used galvanized iron pipes for three or four years, and believe from the experience we have had with them that they are much more durable, at least in our soil, which also contains a great deal of salt. Our streets have been watered for quite a number of years with salt water—which is pumped up from the docks and then sprinkled over the streets in the summer time. Of course, the water evaporates, leaves the salt behind, the salt is washed down into the ground by the rain, and in that way we get very salt ground. In certain portions of the city the soil is of clay and impermeable to water. In the gutters, where the curbs have been laid and the gutters paved, the street department in excavating the clay filled in with gravel so as to prevent the heaving effect of the frost in winter. We found that our service pipes rotted very rapidly indeed where they ran under this filling in the gutters. Where the pipe had been encased originally in the clay it would be absolutely free from incrustation, while that part which ran through the gutter would be completely destroyed. They answered for the gas so long as they were not disturbed; but when the water men came along and disturbed the ground we had to renew hundreds of service pipes. I might say that five out of six were set to leaking by the disturbance of the earth around them, and by the shovelling of the dirt upon them. While the water men did not go to the gutter yet they disturbed the pipes sufficiently to start them leaking underneath the pavement. In putting in renewal pipes we always use galvanized iron. Our experience with them indicates that they will last very much longer.

The Secretary—What is the comparative cost?

The President—The galvanized iron pipe is about 50 per cent. higher than the ordinary iron pipe, with the same discounts.

Mr. Scott—We use wrought iron water pipe. When they are laid in the street we cover them thoroughly with cement. It is first lined with cement, and then covered with cement on the outside. That is a good protection, and I should think it would be cheaper than galvanized iron at fifty per cent. more than common wrought iron. It is very little work to put on the cement.

The President—There is one objection to that which suggests itself to me and that is that it very materially diminishes the bore of the pipe to put cement on the inside.

Mr. Scott—I did not mean to put it on the inside for gas. It is lined simply for water.

The President—I suppose that would be cheaper; but the cost of the service is not very great. In many cases the proportion which the cost of the pipe bears to the digging is quite small.

Mr. Scott—The sheet iron is very thin, and if water or salt comes to it from the outside it eats a hole through it very quickly and destroys the pipe. We have had some that have been laid for seven years, and we have had no breaks for the last two years.

Major Dresser—What is the smallest size that can be used?

Mr. Scott—I think four inches.

Mr. Nettleton—I will state that I had charge of water works where the same kind of pipe that Mr. Scott speaks of was laid in 1860, and it worked for a number of years—holding the water back with a pressure of eight lbs. But that has been gradually displaced with iron pipe. We find that the constant pressure of water on the inside will cause it to ooze through the cement and rust the iron so that it would burst. Where these bursts occur probably nine-tenths of each length of pipe taken out is found to be in a perfect state of preservation—showing that the cement covering both inside and out, although the water is running through it all the time, acts as a perfect preventive of the moisture getting to the iron. I am inclined to think that that would make an excellent coating for service pipes wherever they run through moist ground.

Mr. Coggshall—We have service pipe which has been in use for 16 years; and have never had but more than one break in it. That break was occasioned by its being jarred when laid down, so that the cement had fallen off, and thus the water had gained access to the iron and it had rusted and given away. There was one locality where the soil was very moist and porous. There we could not keep a service pipe over six years before it would become so oxidized as to use it up. I then took a quarter of a pound of resin to a gallon of tar, or in that proportion—making sufficient to coat the pipe, somewhat as Mr. Wood did—by putting it in a trough while hot, then standing it up and letting it drip, and it very soon became hardened. Pipes thus thus treated have been in use for 12 years, and as I have had no trouble with them I presume that they are sound to-day.

The President—In coating it do you take care to exclude the tar from the inside?

Mr. Coggshall—I coat in on the inside as well as on the outside. Then I stand the pipe up and let it drip. It forms a very thin coating on the inside—so thin as not to obstruct the passage of the gas.

The Secretary—I am sorry that I have not obtained more information bearing upon this subject. I had hoped that some member would have something to suggest as the result of his own experience. I have been told by a gentleman who has charge of works in Canada that they use lead pipes entirely for services. He told me how he did it. He laid the pipe in a V-shaped trough. He did not stop to cover it with cement. He simply laid it in a V-shaped trough in order to preserve the proper inclination from the main. We should like to use that if we were sure that it would be satisfactory. We must do something to prevent the destruction of the pipes by reason of the peculiar soil in which they are laid. If there is anything more to be said on this subject I would like to hear it. The great difficulty with lead pipe is the expense.

Mr. Durfee—I have had a little experience in laying pipes where the salt comes in contact with the pipe. My course has been similar to that of Mr. Wood's, although I coat my pipe differently. I take a piece of pipe three inches in diameter, plug up one end and fill it with tar. Then I take the pipe which I am going to use as a service pipe, heat it and place it inside of the three inch pipe. I thus have the pipe thoroughly coated with the tar.

Then I take it out and let it drip. I get a coating that is very uniform, bright, and shiny, and it lasts very well with us. A large part of our place is filled with ashes and muck; and this pipe answers very good service in that locality.

PURIFICATION OF GAS.

The Secretary—I will suggest as another topic the purification of gas. I had hoped to be able to lay before this meeting the results of my experience with the iron sponge. Although I have used the sponge for two or three weeks I am not prepared to make any statement at present, except that I find that I have not pursued the right course. The directions sent out were not very explicit or extended. I hope that it will prove a success. As far as the handling of it is concerned I like it very much better than lime. In many places it is impossible, except at great expense, to procure a sufficient quantity of oyster shells for the manufacture of lime. For a year or two past I have been paying two cents per bushel, and am now paying 2½ cents. In some places, because of the distance from Boston where the shells are shipped, the price is five cents per bushel. Even in my own case, where shells cost but 2½ cents per bushel, I think that it would be economical to use the iron sponge, provided it will perform all that it is claimed it is capable of doing. Mr. Coggshall has used the iron sponge for a year and a-half and I should like to hear his experience.

The President—Before entering upon the discussion of this subject I would like to ask Mr. Slater to give us some figures which he has prepared as to the relative sizes of floor surface of the retorts which he uses now, as against the ordinary 14×26 retort.

Mr. Slater—I was asked that question yesterday and was unable to answer it. I have the figures with me now. The ordinary retort which we were previously using, and which is called the 14×26 retort, has 2,600 square inches by actual measurement. The Davidson retort has 2,924 square inches. That makes 324 inches more of floor surface, which is about 2¼ square feet, or 11.8 per cent.

Major Dresser—How many pounds of coal do you put on to that 2,924 square inches?

Mr. Slater—In using them so far the smallest charge has been 211 lbs., and the largest 293, which is an average of 262½ lbs. In running the same retorts, with tar fires under the benches, we used over 300 lbs.

Major Dresser—That would be 11 inches to the lb. Mr. Dieterich's retort, in his setting, uses about 10 inches to the lb.

IRON SPONGE.

Mr. Coggshall—I will state that I have used the iron sponge for about a year and a-half, and the results have been very satisfactory with me. My boxes are 6×10. The first run of the purifiers only gave about 1,500 feet to the bushel. The next was somewhere about 2,000 feet or 2,500 feet to the bushel. It went on increasing until the maximum was reached, which was 17,000 feet per bushel. In putting in the 70 bushels which the purifiers hold, after about the third run it accumulated in bulk so much that I could only get 55 bushels in the same space of the original material—which is the quantity I am now using. At the present time I am running about 15,000 to the bushel. If I were starting anew I would have a place on purpose for revivification. I have beeen troubled in very cold weather during the past winter, because it would cool off so rapidly that perfect revivification would not take place. The last purifiers, which I opened last week, did not produce such good results as I had been getting previously owing, I think, to this reason. Last summer I could take it out of doors, and in two or three turnings it would become revivified. It is giving very good satisfaction. At the present time we run about 13,000 or 14,000 feet.

Major Dresser—Do you use supplemental purification?

Mr. Coggshall—On the top layer we use a bushel of lime for each purifier. When I first commenced using I tested very thoroughly for carbonic acid and found traces—about two per cent. That was the largest amount that we found at any one time. So far as I could discover by the tests for illuminating power I did not perceive that it made any practical difference. I am using Alleghany coal, and a very little oil as enricher, and at the present time am using one bushel of lime to each purifier. I do not average a gallon of oil to a ton of coal even in the coldest weather. My candle power runs from 16 to 17.

Major Dresser—What is the size of the purifier?

Mr. Coggshall—It is 6×10.

Major Dresser—Does that bushel of lime take out all of the carbonic acid?

Mr. Coggshall—Yes, all that it is necessary to take out. For the sponge I only used one layer.

Major Dresser—What is the depth?

Mr. Coggshall—About 22 inches.

Major Dresser—What do you use for the screen?

Mr. Coggshall—I use a two inch plank board with half inch holes in one inch spaces. It does not increase the back pressure at all.

Mr. Slater—We have not had enough experience with the sponge to justify us in saying much about it. In some respects it has done better work than we were led to hope for, yet we have not reached the result that we expected to get in the use of it. When we first commenced using it they told us not to expect to purify more than 1,600 to 2,000 feet per bushel, and we commenced with between 3,000 and 4,000. Mr. Young, of Alleghany, has been using it for over two years, and he has succeeded in reaching very good results, and is entirely satisfied with it. On an average we have from 1.5 to 2.25 per cent. of carbonic acid without the use of lime. During a portion of the time that we have used the iron sponge our purifiers were constructed with the inlet on top, and the gas, in coming over, deposited some vapor on top, and made a sort of a thick, muddy paste of it, and we were obliged to throw away a portion of it. We changed the inlet to the bottom of the purifier and since that time have not had so much of that trouble.

The Secretary—Do you use sawdust in the bottom of the purifiers to take up any of the tar?

Mr. Slater—That was suggested to us, and we have commenced to use it, but have not yet opened the first purifier that we charged with it.

Mr. Allyn—Do you find that it heats up before you have time to remove it.

Mr. Slater—No; we have not had any difficulty of that kind.

The Secretary—Mr. Coggshall has used it longer, and he says that it becomes more thoroughly saturated.

Mr. Coggshall—Of course it smells very strong. We think that we should change the purifier and clean it out in the morning; and I calculate to turn it over as soon as it begins to warm, and the next morning we turn it over again, and continue turning it over so long as there is any heat in it.

Mr. Allyn—In larger works where there are purifiers 20 feet square it requires nearly half a day to remove the material. In such cases I fancy that the latter part of it would be of a pretty high temperature before being removed. I have understood that parties who have attended to revivifying have had pretty serious difficulty because of the fact that it would become so hot that it would almost ignite.

Mr. Slater—We had such an incident three or four months ago. By some means they drew in a small quantity of air which had a tendency to revive the iron sponge as it was passing through; and the superintendent got frightened. We get over 17,000 feet to the bushel and still the gas was clean; but the purifier began to heat up, and the superintendent changed it off. The probable explanation of that is that the air revivified the sponge in passing through with the gas.

The President—About a year ago there was an interesting account in a London journal about an experiment made in continuous purification by the addition of a small quantity of air to the gas for the purpose of the constant revivification of the iron. I do not remember the journal but you will find it in the report of some of the numerous meetings there.

Mr. Stiness—Mr. Allyn asked the question about removing the quantity of iron. I think that the Worcester gas company have purifiers which are 20×24. Some years ago I obtained the right to use the Cartwright and St. John oxide of iron, and used it very successfully for two years while my purifiers were very small. Wishing to know the correct analysis of this sponge, I sent to the Patent Office and got a copy of the claim of Connelly's patent, and I found that it varied but very little from the original Cartwright and St. John iron purification.

It consisted more in the previous preparation of the iron. There was a slightly modified form of using it. My experience when using it with small purifiers was that it did not heat at all. In Worcester I am very confident that they have not the least trouble in taking the iron from the purifiers, which are 20×24, and therefore contain a very large quantity. Having now very large purifiers for our make of gas we have not used the iron for several years; but I believe that it is a very good thing to use in connection with lime.

At the time that I used it I was obliged to use a great deal of lime to take out the carbonic acid. We had very favorable results from that. This iron sponge and the oxide of iron, as prepared by Cartwright and St. John, varies but very little indeed. We use a layer of sawdust on the lower tray, and then use the iron in a layer of two inches upon the boards. Of course the holes were countersunk and made larger on the under side than on the top. I believe that the iron sponge is good for use if you are the least crowded for purification. Sometimes when you have an extreme amount per square foot of purifying surface you can get as good results from shell lime.

[To be continued.]

Electric Light in Denver.

Although the city has contracted for lighting the streets of Denver with this light, no visible efforts have yet been made by the company having the contract, up to this time, towards being ready by May first, the time agreed upon.

When work commences the progress will be duly reported.

THE AMERICAN GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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SATURDAY, APRIL 2, 1881.

Official Report of Examinations of Gas for two Weeks ending March 26, 1881, made at the Photometrical Room of the Department of Public Works.

Corrected Illuminating Power.

1881. Mar.	Time of Day at which Test were made.	New York Gas-Light Co.	Manhattan Gas-Light Co.	Mutual Gas-Light Co.	Metropolitan Gas-Light Co.	Harlem Gas-Light Co.	Municipal Gas-Light Co.
		†	*	†	‡	*	†
14		26.46	19.78	24.47	22.61	19.72	30.24
15	Between	25.38	19.42	26.18	22.73	19.32	30.00
16	9.30 A.M.	24.23	19.13	25.71	22.34	19.09	30.12
17	and	26.68	19.23	26.64	22.55	19.47	30.58
18	1 P. M.	26.00	19.48	26.32	22.85	19.22	30.31
19		25.45	18.83	28.68	22.60	18.65	29.96
	Average	25.69	19.31	26.33	22.61	19.24	30.20
21		24.18	19.68	27.24	23.27	18.61	30.49
22		24.99	19.51	26.86	23.79	18.27	31.94
23		26.12	19.95	27.78	22.54	17.93	31.60
24		27.33	19.97	28.76	22.78	17.90	31.30
25		26.88	20.37	28.33	23.18	18.60	30.12
26		25.44	19.86	25.87	22.57	19.35	30.77
	Average	25.82	19.72	27.47	23.01	18.44	31.03

* Five foot lava tip with check.
† Bray's slit union, No. 7.
‡ Bray's slit union, No. 6.
E. G. LOVE, Gas Examiner.

Cast Iron.

Cast iron was not in commercial use before the year 1700, when Abraham Darby, an intelligent mechanic, who had brought some Dutch workmen to establish a brass foundry at Bristol, Eng., conceived the idea that iron might be substituted for brass. This his workmen did not succeed in effecting. A Welsh shepherd-boy named John Thomas, had been received into Abraham Darby's workshop some little time previous to this. While looking on during the experiments of the Dutch workmen he told Mr. Darthat he thought he saw where they had missed it. He and Mr. Darby remained alone in the workshop all night, struggling with the refractory metal and imperfect moulds. The hours passed on and daylight appeared, but neither would leave his task; and just as morning dawned they succeeded in casting an iron pot complete. The boy entered into an agreement with Abraham Darby to serve him and keep the secret. He was enticed by the offer of double wages to leave his master, but he continued faithful, and from 1709 to 1822 the family of Thomas were confidential and much-valued agents to the descendants of Abraham Darby.—*Western Manufacturer.*

Edison Electric Light Company.

On the 22d inst. the Board of Aldermen of New York city granted permission to the Edison Electric Light Company to lay tubes, wires, conductors, and insulators, and to erect lamp posts in the streets, avenues, parks, and public places in this city for the purpose of supplying electricity for illumination. All excavations in streets, removals and replacements of pavements or sidewalks are to be made according to the direction of the Commissioner of Public Works, and under such conditions as to security against damage to sewers, water pipes, or gas pipes, as may be prescribed by the Mayor, Comptroller, and Commissioners of Public Works, who are now by law authorized to make provision for lighting the streets of the city. Whenever a permit shall be granted to open the streets, pavements, or sidewalks for the purpose of laying the tubes, wires, conductors, etc., a sum equal to 1 cent for each lineal foot of street occupied shall be paid to the city. Nothing in the resolution should be deemed to authorize the laying of mains or pipes for conveying gas.—*Engineering News*, March 26.

Sale of the McConnel Tract.

A large tract of land in Elizabeth township, Allegheny county, opposite Scott Haven—Baltimore and Ohio Railroad—known as the McConnel tract, was sold recently to an eastern firm for $100,000. The tract contains 500 acres, and has been owned by Judge Mellon these many years. The Youghiogheny will be bridged at Scott Haven at a cost of $40,000, and the mining and shipping of coal from the Elizabeth township side will be commenced the coming summer.—*Am. Manufacturer.*

Springfield (Ohio) Water Works.

The contract for furnishing twenty-eight miles of pipe for the Springfield (Ohio) water works was awarded to the Warren Foundry and Machine Company, of Phillipsburg, at $30.61 per ton, delivered. All bids for laying were rejected, and will be readvertised. The hydrants were divided between the Chapman Company and R. D. Wood & Co.; the valves were divided between the Chapman, Ludlow, and two other companies.—*Engineering News.*

The Dover Gas Apparatus Exhibition.

A very complete and successful exhibition of gas cooking, heating, and lighting apparatus was lately held in the town of Dover, England. Some complaint was made by a number of firms who desired to exhibit lines of goods, that sufficient time had not been granted to allow of a complete and thorough grouping of the different articles which they desired to place on exhibition.

The affair was held under the auspices of the gas company, and, all things considered, made a very creditable showing.

Messrs. West Brothers presented a new portable asbestos fire, made to hang on the bars of a grate, so that the heat may not be lost up the chimney. An imposing display was made by Mr. Sugg of his various burners, painted shades, etc. Another noticeable feature was a collection of gas meters, etc., by Messrs. W. & B. Cowan.

We would like to be able to announce the fact that something of the kind will take place soon in this country.

Natchez (Miss.) Gas Light Company.—At the annual meeting of the stockholders of the Natchez Gas Light Company, held yesterday, the following officers were re-elected to serve for the ensuing term: President, E. B. Baker; Directors, S. E. Rumble, J. C. Schwartz, A. C. Britton, and L. G. Aldrich.—Natchez *Democrat*, Mar. 25.

Gas Stocks.

Quotations by G. W. Close Jr., Broker and Dealer in Gas Stocks.
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APRIL 2, 1881.

☞ All communciations will receive particular attention
☞ The following quotations are based on the par value of $100 per share.

	Capital.	Par.	Bid.	Asked
Gas Co.'s of N. Y. City.				
Central	$466,000	50	60	65
Harlem	1,800,000	50	62	65
" Bonds	170,000			103
Manhattan	4,000,000	50	175	180
Metropolitan	2,500,000	100	130	135
" Scrip	1,000,000	...	102	103x
Mutual	5,000,000	100	70	72
" Bonds, go'd.	900,000	1000	100	104
Municipal	1,500,000	100	150	155
" Bonds	750,000		106	110
New York	4,000,000	100	94	97
Northern	270,000	50	—	100
Gas Co's of Brooklyn.				
Brooklyn	2,000,000	25	110	115
Citizens	1,200,000	20	45	50
" S. F. Bonds.	320,000	1000	100	105
Fulton Municipal	1,500,000	100	55	60
Peoples	1,000,000	10	25	30
" Bonds	290,000	...	101	104
" "	250,000	...	70	75
Metropolitan	1,000,000	100	55	60
Nassau	1,000,000	25	45	48
" Ctfs.	700,000	1000	95	100
Williamsburgh	1,000,000	50	60	64
" Bonds		...	98	103
Kings Co	135,000	100	55	60
" Bonds	40,000	—	—	—
Richmond Co., S. I.	300,000	...	70	75
Out of Town Gas Companies.				
Buffalo Mutual, N.Y	750,000	100	72	76
" Bonds	200,000	1000	95	100
Citizens, Newark	918,000	50	85	90
" " Bds.	124,000	—	105	10
Chicago Gas Co., Ills			125	—
Cincinnati G. & C. Co.			178	1
Consolidated, Balt.			71	72
Bonds			107	—
East Boston, Mass		25	114	120
Hannibal, Mo	100,000	100	95	100
Hartford, Conn	700,000	25	140	144
Halifax N. S	400,000	40	148	150
Hamilton, Ontario	150,000	40	117½	
Jersey City	750,000	20	140	150
Jacksonville, Ill	120,000	50	100	...
Lewistown Maine	400,000	100	—	100
Laclede St Louis Mo.	1,200,000	100	108	110
Montreal, Canada	2,000,000	100	153	154
New Haven, Conn		25	132	—
Oakland, Cal			33	34
Peoples, Jersey City		...	95	100
" " Bds.				5
Pittsfield, Mass			120	130

Rochester, N. Y.....		50	70	80
" Citizens		100	30	35
Woonsocket, R. I....	150,000	100	80	...
Wilmington, Del....		50	174	...
Yonkers.....		50	30	32
Rondout & Kingston			75	80
St. Louis Missouri..	600 000	50	250	254
San Francisco Gas-Co., S. Fr'isco Cal.			76	77
Toledo, Ohio.....			95	97
Troy, Citizens.....	600,000	100	—	—
Washington, D. C...	1,500,000	20	130	200
" Scrip	500,000	20	150	160

The following gas securities were sold at auction: $2000 bonds of Consolidated gas company, of Baltimore, due 1910, at 107; 25 shares of same company' at 70¼; 25 shares of Yonkers gas company, at 30, and $352 scrip, of same company, at 29. 15 shares Manhattan, at 182; 30 shares Metropolitan, at 138½; 25 shares Metropolitan, at 132½.

Advertisers Index.

Page

GAS ENGINEERS.

William Farmer, New York City 166
G. Warren Dresser, New York City 161

GAS WORKS APPARATUS AND CONSTRUCTION.

Herring & Floyd, New York City 163
T. F. Rowland, Greenpoint, L. I. 163
Delly & Fowler, Phila., Pa 163
Kerr Murray Mfg. Co., Fort Wayne, Ind. 163
Stacey Mfg. Co., Cincinnati, Ohio 163
Bartlett, Hayward & Co., Baltimore, Md 163
P. Munzinger, Phila., Pa 163
Brown & Owen, Phila., Pa 163
Morris, Tasker & Co., Limited, Phila., Pa 163

GAS AND WATER PIPES.

A. H. McNeal, Burlington, N. J 162
Gloucester Iron Works, Phila., Pa 162
R. A. Brick, New York City 162
James Marshall & Co., Pittsburgh, Pa 162
R. D. Wood & Co., Phila., Pa 162
Warren Foundry and Machine Co., Phillipsburgh, N. J 162
Mellert Foundry and Machine Co., Reading, Pa 162

WASHERS AND SCRUBBERS.

A. C. Wood, Syracuse, N. Y 135
G. Shepard Page, New York City 158

RETORTS AND FIRE BRICK.

J. H. Gautier & Co., Jersey City, N. J 160
B. Kreischer & Sons, New York City 160
Adam Weber, New York City 160
Laclede Fire Brick Works, St. Louis, Mo 160
Brooklyn Retort and Fire Brick Works, Brooklyn, N. Y. 160
Borgner & O'Brien, Phila., Pa 160
Gardner Brothers, Pittsburgh, Pa 160
Henry Maurer, New York City 160

DIETERICH'S REGENERATOR FURNACE.

Charles F. Dieterich, Baltimore, Md 142

GAS METERS.

Harris, Griffin & Co., Phila., Pa 166
American Meter Co., New York and Philadelphia 167
The Goodwin Gas Stove and Meter Co., Philadelphia, Pa 167
Helme & McIlhenny, Phila., Pa 167

GAS STOVES.

The Goodwin Gas Stove and Meter Co., Phila. Pa 168
Retort Gas Stove Co., Providence, R. I 144

VALVES.

Ludlow Valve Manufacturing Co., Troy, N. Y 160
Chapman Valve Manufacturing Company, Boston, Mass 160

EXHAUSTERS.

P. H. & F. M. Roots, Connersville, Ind 161
Smith & Sayre Manufacturing Co., New York City 161

GAS COALS.

Penn Gas Coal Co., Phila., Pa 165
Perkins & Co., New York City 164 165
Cannelton Coal Co., New York and Philadelphia 165
New York and Cleveland Gas Coal Co., Pittsburgh, Pa 165
Newburgh Orrel Coal Co., Baltimore, Md 165
Despard Coal Co., Baltimore, Md 165
Tyrconnel Coal Co., Baltimore, Md 164
Fort Pitt Gas Coal, Pittsburgh, Pa 165
West Fairmont and Marion Coal Co., New York City 164
Montauk Gas Coal Co., New York City 165
Lovejoy and Pardee R.R. Coal Agency, N. Y. City 164

GAS ENGINES.

Schleicher, Schumm & Co., Phila., Pa 135

STEAM STOKERS.

A. Q. Ross, Cincinnati, Ohio 159

STEAM ENGINES.

F. C. & A. E. Rowland, New Haven, Conn 158

PURIFIER SCREENS.

George D. Cabot, Lawrence, Mass 143

BURNERS.

G. Gefrorer, Phila., Pa 164

STREET LAMPS.

S. G. Miner, New York City 134

PURIFYING MATERIAL.

Connelly & Co., New York City 158

STEAM BLOWER FOR BURNING BREESE.

H. E. Parson, New York City 140

PROCESSES.

Gwynne Harris New York City 162

EDGE'S PROCESS. REMOVING CARBON

D. D. Flemming, Jersey City, N. J 158

GAS FIXTURES.

Mitchell, Vance & Co., New York City 161

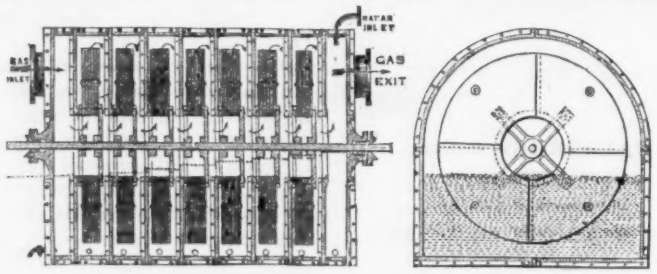
CEMENT.

S. L. Merchant, New York City 161
F. O. Norton, New York City 161

BOOKS.

Economy of Gas as a Fuel 164
Journal des Usines a Gaz 92
Gas Analyst's Manual 92
Scientific Books 162
Cathels' Gas Consumers' Manual 167
Fodell's Book-Keeping 167
Review of Gas and Water Engineering 167

KIRKHAM, HULETT & CHANDLER'S



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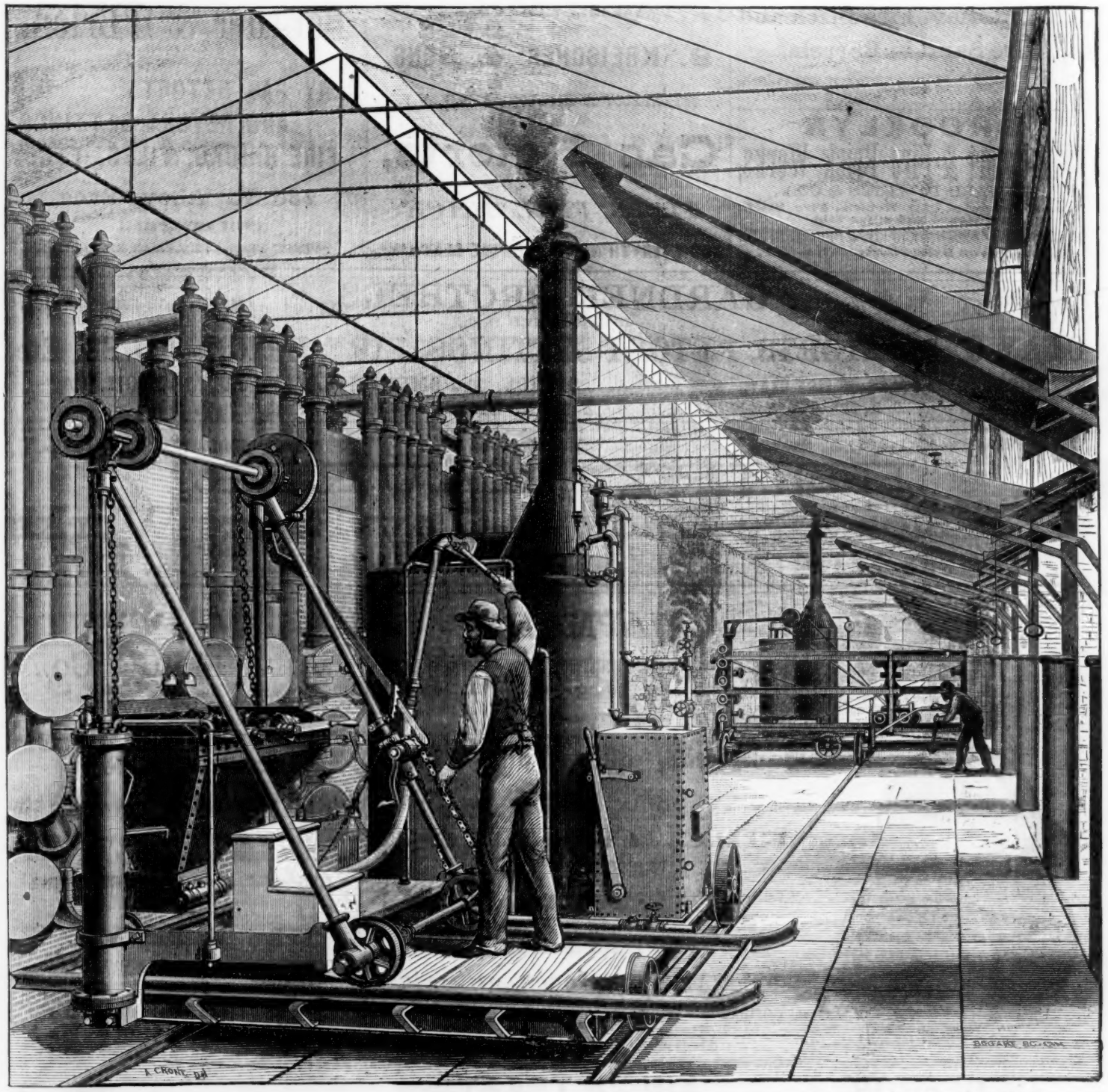

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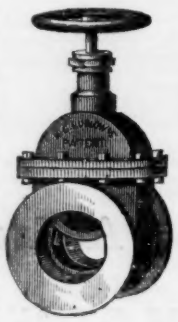

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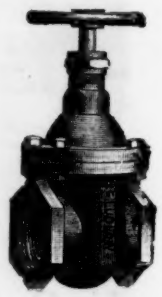

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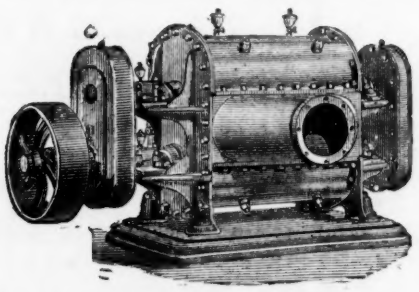

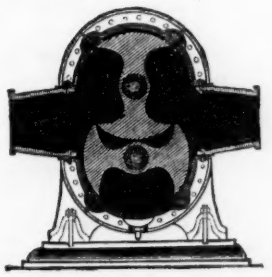

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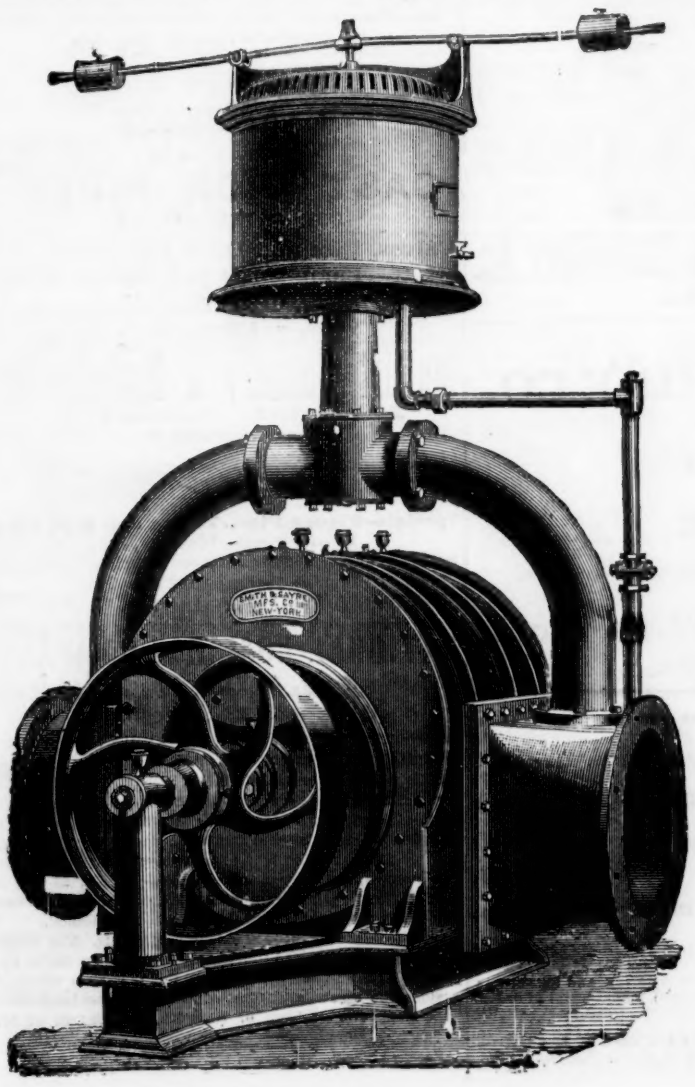

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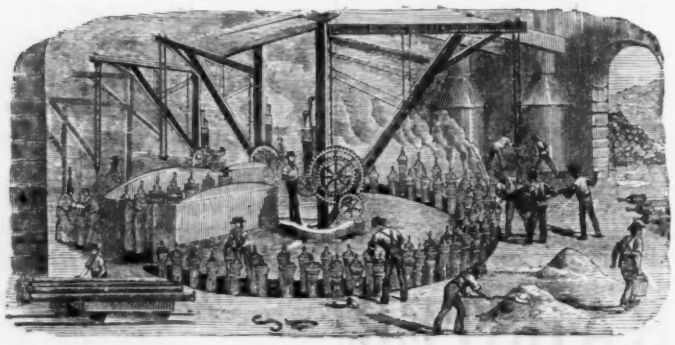

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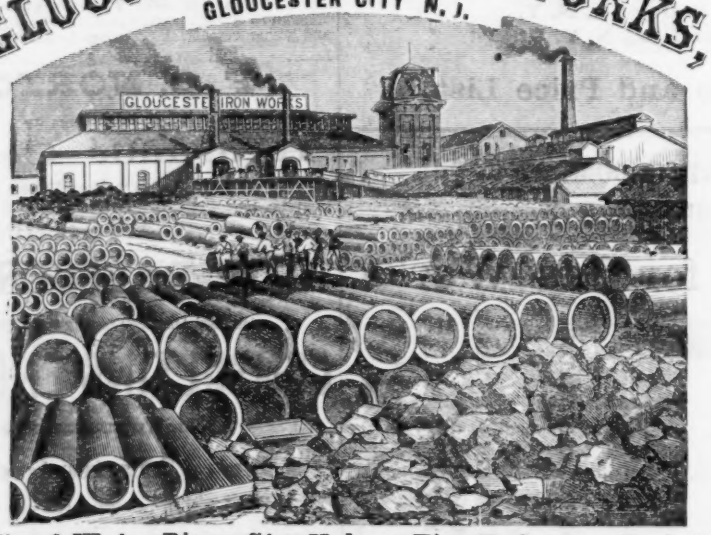

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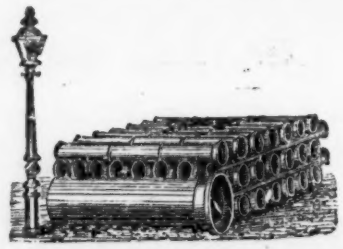

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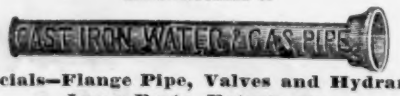

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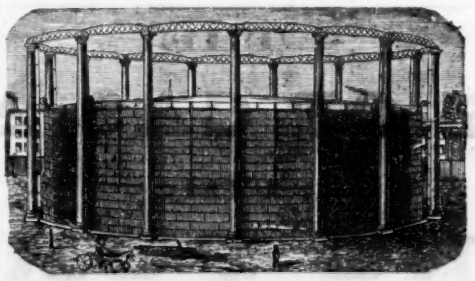

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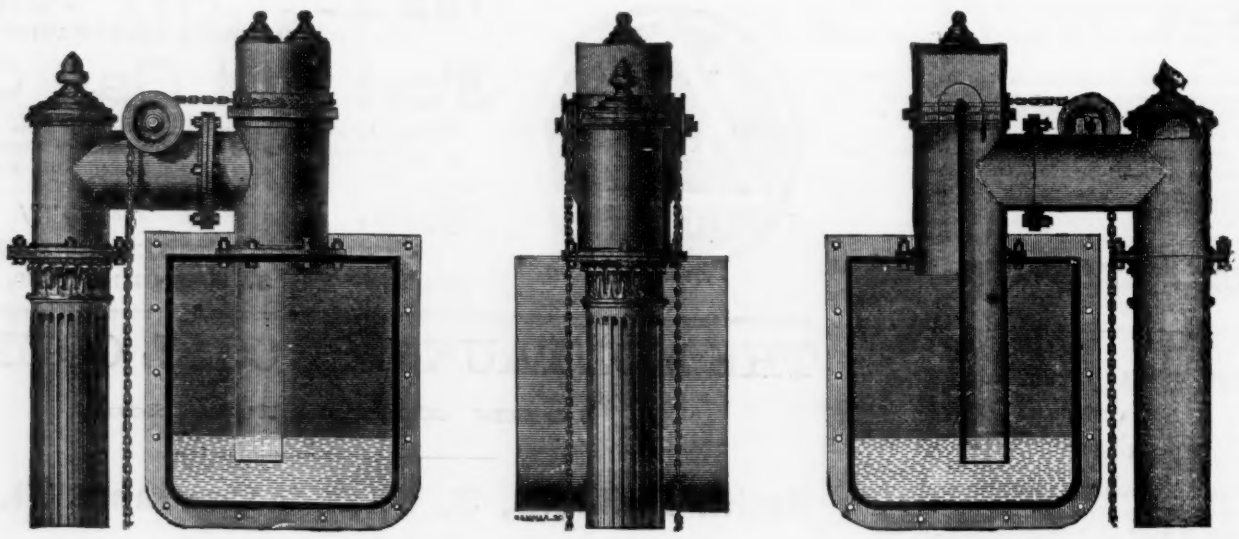

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